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ABSTRACT

The approach taken in preparing this collection of papers was to focus upon questions of an applied nature pertaining to the studies of information needs and connected with the theory of scientific information, rather than to approach the problems of user needs in information science from a purely theoretical point of view. The nine papers included in this volume are: Information Requirements as a Basis for the Planning of Information Activities; Reflection on the Relationship between Users and Information Workers; Information System and Its Users; A Pragmatic Approach to Research in Information and Documentation; Encyclopaedic Dictionaries Satisfying User Needs; Scientist's Creative Potential: Clue to His Information Needs; Emergence of Industrial-Line Processes in Science. Ephemeron Teams: New Form of Science Organization; The Study of Specialists' Information Needs as a Precondition for and a Means of Information System Streamlining; and, A Contribution to Research on Information User Needs. (A previous publication in this series, "Problems of Information Science," is ED075030.) (Author/SJ)

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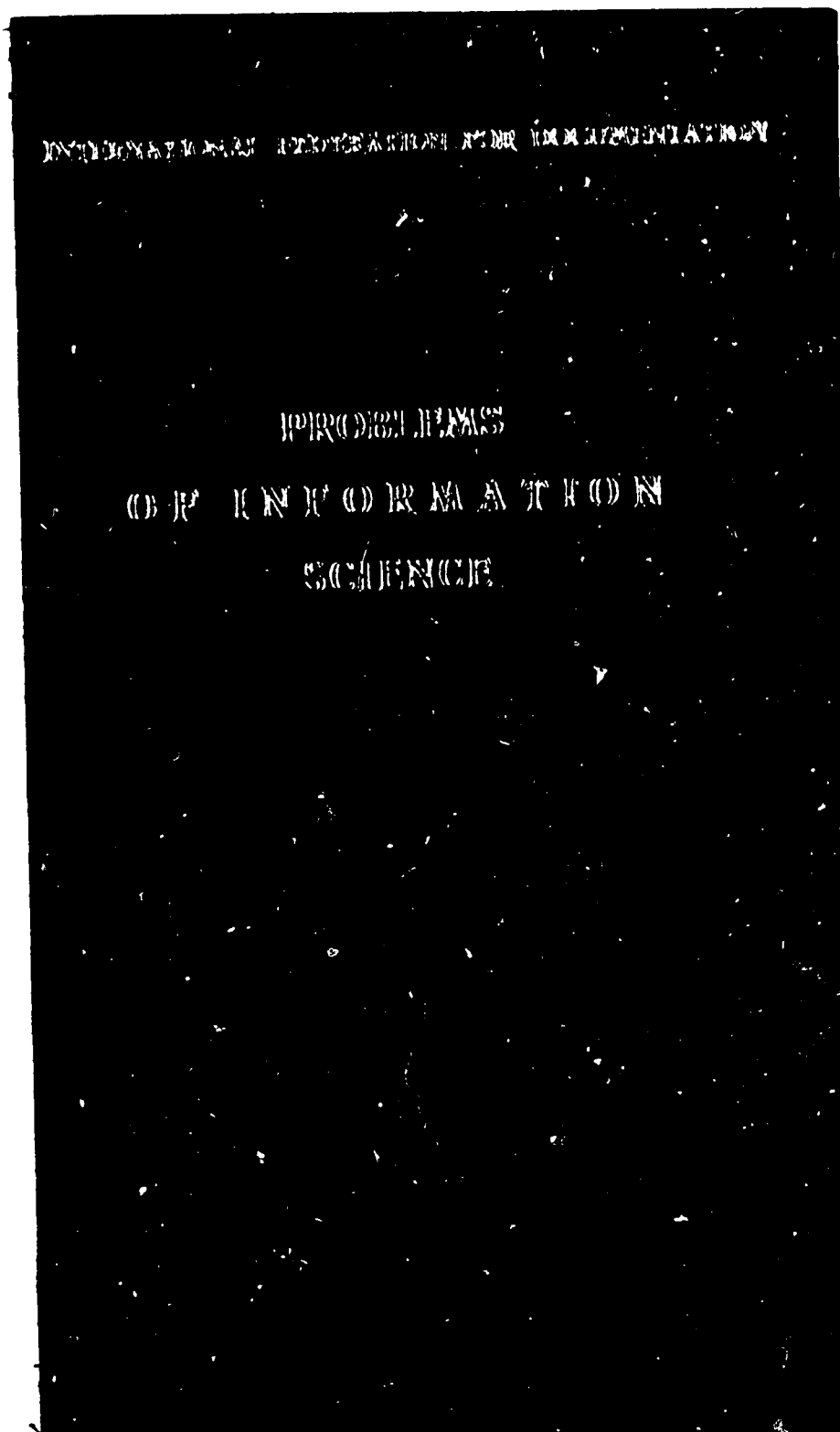

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PROBLEMS OF INFORMATION USER NEEDS

Edited by Prof. *A. I. Mikhailov*

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AND TECHNICAL INFORMATION

MOSCOW 1973

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PREFACE

The collection of articles «Problems of Information User Needs» is the third publication of this kind issued by the FID Research Committee «Research on the Theoretical Basis of Information» (FID/RI). The first collection «Theoretical Problems of Informatics» (FID 435) came off the press in 1968. The second volume entitled «Problems of Information Science» (FID 478) was published in 1972.

The problems of information user needs dealt with in this collection are not new ones for the FID/RI Committee. As early as 1968, the volume «Theoretical Problems of Informatics» carried an article on the subject by the well known Polish researcher A. Wysocki, Director of the UNESCO Division of Scientific and Technological Documentation and Information.

The 2nd collection «Problems of Information Science» carried an article on this problem by P. Atanasiu.

The Editorial Board of the FID/RI Committee's publications has formulated its viewpoint with regard to the problem of studying information user needs and requests. This viewpoint was expressed in the prefaces to the volumes «Theoretical Problems of Informatics» and «Problems of Information Science», the preface to the former having been contributed by the author of these lines and to the latter — by A. I. Chernyi. Issuing this collection, which is entirely devoted to problems of information user needs, we wish to briefly review the theses expressing in total our concept of approach to the problem under investigation.

These theses are as follows:

— The problem of studying information user needs and

that of examining the principles and methods used to identify both information needs and the adequacy of their expression in user requests, are regarded as most important trends in applied science connected with investigation of theoretical problems of information science. It is this trend that determines the necessity of carrying out a wide range of studies in this field;

— Fundamental research into information needs shows that the types of information needs and categories of information users, identified as a result of the studies, confirm corresponding data known from the previous practice of publishing scientific and technical literature and its use as an information communication channel in science and technology with the help of traditional methods;

— This research reveals at the same time that each information need is of an individual nature and, in a way, is unique. Therefore, it is necessary to accumulate big data files in order to identify general theoretical regularities in this particular case;

— Proceeding from the aforesaid, the study of information practice is the main field of research into regularities, governing information needs at the present stage of the theoretical basis of information science;

— The research into information needs is closely linked with research into creative work done by a scientist which is, strictly speaking, beyond the scope of information science as such.

Based on the theses of the above-mentioned concept our task, when preparing the collection, was to elucidate upon questions of applied nature pertaining to the studies of information needs and connected with the theory of scientific information, rather than to attract the reader's attention to the appropriate problems of information science from a purely theoretical point of view. This approach was prompted by our conviction of the necessity to couple research into purely theoretical aspects of information science with studies of applied problems, for this coupling in present-day conditions of ever-increasing interaction of science and practice ensures the highest possible effectiveness of theoretical research. We sought to include into the volume such articles that could reflect both the wide range of problems dealing with information needs, and different practical approaches to their solution. We believe

that the papers included in the volume have justified such an approach which enables us to give definite assessment of these articles from the point of view of the above-mentioned theses.

Another distiguishing feature of the volume is that our collegues, working in the field of librarianship and library science, have taken an active part in compiling the volume. Inviting them to contribute articles to this collection, we were guided by the recommendations adopted at the Joint Meeting of FID/IFLA Officers and Committee Chairmen, held in Brussels on 15—16 February, 1971. By choosing such an approach to the selection of material for the collection we were also guided by the conviction of the fruitfulness and usefulness of constant cooperation with our colleagues — theoreticians and practical workers in librarianship, a field of human endeavour with which information science maintains very close historical and functional links.

On this occasion, I have the pleasure of expressing, on behalf of the FID/RI Committee, our gratitude both to the librarians, who have contributed articles to the volume, and to the IFLA Committee on Theory and Research in Librarianship and its Chairman Dr. O. S. Chubarjan (USSR) for their kind cooperation in preparing the volume for publication.

The first paper «Information Requirements as a Basis for the Planning of Information Activities» is written by F. Kneitschel (GDR). Dwelling on this paper, we should like to stress the importance of the author's historical approach both to the development of the scientific information activities as a whole and to the interaction between the processes of generating information and organizing its use. Since principles of a complex approach are applied on an ever larger scale in science in general, and in information science in particular, it is becoming ever more important to consider information activities as a totality of separate aspects of information service which took shape in a certain historical sequence.

Scientific information activities and their component parts have taken shape as a result of a complex historical process, the development of which depended, on the one hand, on social demand for information, and, on the other, on the intellectual and technical possibilities of informati-

on transfer which society disposed of at each stage of this process. Social demand for information and user needs have always played an important — perhaps, the decisive — role in the development of information activities and the theses, formulated by the author of the paper, are, in our view, its serious asset. The only thing we might object to is that the author, in our opinion, unnecessarily stresses that qualitatively new methods and means of information service came into being «spontaneously». After all, the author himself says that the development of information communication in science and technology is a single, indissoluble historical process. Within this process each qualitative leap is the result of gradual quantitative changes. The somewhat tary, qualitatively new forms and methods of providing information service do not emerge all of a sudden, on a blank space, so to speak, but are taking shape within the existing ones gradually and come into being precisely due to the growing social needs.

From the theoretical point of view the author's approach to classification of information needs deserves attention, as it provides for the identification of their main types and the latter's interaction with the «science-technology-production» cycle.

The paper contributed by D. Vidovič (Yugoslavia) is devoted to the problems of relationship of information workers with the users and to the problems of mutual understanding between them. This is the aspect that exerts substantial influence on the organization of information service. Both the very standard of information service and the extent to which information needs are met largely depend on the proper solution of the problems just mentioned. However, recommending the reader to get acquainted with the article and acknowledging the importance of establishing and developing collections of information sources, we beg to disagree with the author who asserts that «the most serious problem in the field of information is how to establish and develop a collection of documents». This might be true if information problems were tackled from the viewpoint of one aspect of information service only, i. e. the service rendered by libraries. However, if a complex approach is effected, i. e. if information problems are tackled from the viewpoint of all aspects of information service, then rapid current awareness information, orga-

nization of information retrieval according to information requests and a number of other problems are equally important. We believe that in this case a complex approach to the problems is more efficient.

The paper by R. P. Vtcherashniy (USSR), «Information System and Information Users», raises some interesting and important problems, such as the role played by information in organizing interaction of different spheres of the «science — technology — production» cycle and, hence, the identification of characteristics of definite groups of information users; the importance of forecasting the development of information requirements and of designing appropriate models; the necessity to properly develop, along with the services dealing with centralized processing of information, the local links of the information service system, because those links can take into account as fully as possible individual requests of information users at large. We hope the reader will take an interest in this article, though certain theses advanced by the author — for instance, his conclusion that the development of information retrieval systems precludes the necessity of publishing abstract and bibliographic information — seem to be debatable.

The article «The Pragmatic Approach to Research in Information and Documentation» by B. Tell and Z. Gluchowicz (Sweden) deals mainly with the problem of meeting user needs with the help of an SDI system. The authors look into the problem by investigating the work of the automatic retrieval system at the Royal Institute of Technology in Stockholm. Giving a detailed description of the system, the authors touch upon a number of principled questions of user needs, including such aspects of the problem as training of information users. The article could be recommended to the reader without any further comments, but the theses set forth by the well known Swedish researcher and his colleague at the beginning of the article and viewed by them as a follow-up on the dialogue conducted by the author of the preface at the 12th FID Congress in Budapest in September 1972, compel me to say a few more words.

The authors of the paper point to the contrast in the approaches to the problem of meeting the information user needs. They reveal the contrast in the fact that «While

Prof. Mikhailov adjusts his input and processing methods to this end, our operations are solely based on the readjustment of the screening capability of the system and on various ordering methods».

The assertion that the two approaches differ to a certain extent is right, and the difference is justified if you take into account the fact that the practical tasks these approaches are based on are different, too. In the discussion B. Tell refers to, I meant processing of primary information sources while preparing secondary information publications, and we by no means claim this to be the only possible approach, nor do we extend it to all other cases. Such processing procedures which — as practice has convicingly shown — would be carried out in a centralized way in big information centres make it possible to meet information user needs by orienting the centres towards bigger user groups. This is sort of «macro approach» which takes into account not the individual user needs, which is out of the question in this case, but those or large groups of users. Orientation towards the requirements of these groups results in different types of secondary information publications, in different systems of subject headings and special branch volumes and in the arrangement of the material within headings. In case of individual information service systems which, we believe, our opponents primarily refer to, and which include SDI services, the problem to be solved is quite different in principle. Here concrete needs of each individual user and the problem of meeting these needs come to the fore whereas the process of information service proper consists in selecting, from the materials screened at the «input» the part of documents which are relevant to each individual request. It should be stressed that the system described by the authors uses, as information sources, abstract and bibliographic publications, i. e. publications containing the information already processed at the input end.

This is where our approaches to the problem differ and both we and our opponents recognize it. But inlike the authors, we do not see any contrast in the approaches. On the contrary, in our view, they supplement each other. We believe, our opponents are right when they stress the necessity to arrive at a «synthesis, namely an optimization

of essential elements in the total information transfer chain...»

The article «Encyclopaedic Dictionaries for Satisfying User Needs» contributed by the FID President Prof. H. Arntz (FRG), a well known researcher of problems of information science, deals with an interesting aspect of the problem of meeting numerous user needs on a very wide range of questions. Such an interpretation of the approach to the problems of user need studies reflects urgent demands made by the modern scientific and technological revolution. These demands aroused interest in encyclopaedias, a specific kind of information publications. Now that ever wider sections of scientists and engineers have an increasing need for encyclopaedic knowledge, this question is becoming ever more urgent.

We expect the readers will show interest in and appreciation of the paper based on extensive material and containing many historical data.

The next two articles contributed by Soviet scientists are devoted to problems related both to information science and to processes of scientific work exploration.

In his article «Scientist's Creative Potential: Clue to His Information Needs» D. E. Shekhurin (USSR) attempts to trace the direct link existing between these two factors. The author raises problems dealing with: the role played by the informational situation in a scientist's creativity; the raising of efficiency of an information service system by orienting it towards better satisfaction of information needs of scientists having a higher creative potential; the importance of assessing the creative potential when identifying a scientist's information needs. Of course, we do not claim that all the problems raised have been completely solved. Moreover, we believe, the author did not set that task. Nevertheless, it is necessary to attract the attention of broad information circles to the above-mentioned problems, and, in our view, one of the obvious merits of the paper is that the author did raise those problems.

However, we deem it necessary to make one more remark concerning this article. This remark is rather of terminological nature. We think, the term «priority information services» does not suit all right when ways are sought of how to meet best information needs of scientists having a high creative potential. The author himself points out

that giving «priority information services» to leading scientists should not be to the detriment of information service provided to scientific workers occupying a medium position in science or fulfilling auxiliary functions. It would be more appropriate to speak of the specific of those forms of information service that can meet information needs of leading scientists as fully as possible and facilitate the raising of their creative potential rather than of «priority information services».

The problem of a scientist's information activeness as a feature characterizing his creative potential and a form in which this potential finds outer reflection is coupled with the problems dealt with in the paper by Z. M. Mulchenko, Yu. V. Granovsky and A. B. Strakhov (USSR). The authors explore with the help of scientometric methods informational activeness of leading scientists who head permanent and temporary bodies of specialists. True, the article by these authors is beyond the scope of problems dealing with the satisfaction of user needs in the strict sense of the term. However, we believe that the authors' approach to the exploration of creative processes in science interacted with Informatics was a good reason for having the paper in the volume.

The last two articles are contributed by our colleagues working in scientific and college libraries, and are devoted to the investigation of information users' rquests and interests within the scope of information activities of libraries.

The paper «The Study of Specialists' Information Needs as a Precondition for and a Means of Information System Streamling» by T. M. Pachevskij (USSR) deals with these problems in connection with the activities of a big scientific and technical library serving scientific workers and engineers within a big scientific and industrial region. The study is based on experiments carried out by the State Public Scientific and Technical Library of the Siberian Branch of the USSR Academy of Sciences.

The collection ends up with the paper by H. Jarecka and I. Aleksandrowicz (Poland) entitled «A Contribution to Research on Information User Needs».

The investigation of the problem is based on research done at the libraries of two Cracow higher schools — the Academy of Mining and Metallurgy and the Cracow Scho-

ol of Economics. This problem is assuming a still greater importance, for it has a close relationship with problems of training future managerial personnel in science and industry as information users. The views of Soviet information workers on these problems were expressed at the Bucharest International Simposium devoted to the training of information users and the studying of their needs.*

We thought it reasonable to include the paper contributed by our Polish colleagues into the volume despite the limited results they obtained, because it is essential to study the problems related to the satisfaction of information user needs and to the training of information users at educational establishments.

In conclusion, I should like to express hope that although most of the reviewed articles are largely of applied nature their publication by the FID/RI Committee will contribute to the elaboration of theoretical and methodological problems dealing with studies of information user needs and requests.

Professor *A. I. Mikhailov*
Chairman of the FID/RI Committee

* R. S. Gilyarevskii. Experience in Training Users of Scientific Information at the Moscow M. V. Lomonosov University. «Training of Information Users and Studies of User Needs». The International Simposium. Abstracts and Reports. 14—15 November, 1968. Bucharest (In Russian).

F. Kneitschel
(GDR)

INFORMATION REQUIREMENTS AS A BASIS FOR THE PLANNING OF INFORMATION ACTIVITIES

Any organized information activity will be useful only if it meets social requirements. It should help the user to fulfil his tasks more efficiently and more profitably. This is its only objective, no matter whether simple or complicated means and methods, including even a modern information system, are used.

Whoever wants to plan information activities — including the development of systems — must know his potential users and properly understand their information requirements, recognize them early enough and determine them in a suitable manner. The better he knows to determine future requirements the smaller the development risk will be.

By society's requirements for scientific and technical information we understand the quantity of information needed by the working people in the course of socially necessary creative working and qualification processes. It is necessary in this connection to always take into consideration the interaction between requirements and information yield. The world's information yield must flow into information pools which meet the requirements of society; moreover, differentiated information services must be created and made available purposefully so that any individual may have, to the largest possible extent, access to information from science and technology needed by him in his working process.

The term «requirements» is most commonly used in economy as a category of commodity production. «The requirements represent needs, that are derived from monetary funds, of the productive consumers for means of

production, and of the social and individual consumers for means of consumption... They constitute a dynamic category which — on the market — appears as demand» [1].

If we want to use the term «requirements» for the purpose of scientific and technical information, we should bear in mind that here this term is not fully identical with the term «requirements» used in economy. The main reason for this must, in our opinion, be seen in the fact, that though information has certain traits of a commodity, it does not, in general, have the characteristic features of a commodity.

Information requirements, too, appear as a demand. They change with time and have their origin in the needs of the people. The needs for information are the driving force for the development of the information requirements. The way in which they become effective will depend on the objectives, the production relations and the stage of the development of the productive forces in the society concerned. Science as a productive force includes also the information pools and services utilized during working processes.

Several hundred publications dealing with information requirements prove that such ideas have gained more and more ground during the last decade [2]. It is obviously no longer sufficient in social practice to collect the findings as completely as possible. It is equally necessary to organize them in accordance with the requirements and to exchange the purposefully.

The external conditions which gave rise to the growing interest in the information requirements are the increase in and the progressive differentiation of the information yield and the groups of users. The deeper reason for this phenomenon lies in the fact that during the last decades science has largely developed into a direct productive force whose performances make themselves felt in all spheres of society, and that it does no longer constitute a mere means but rather a starting point of production.

The comprehensive, extensive and more and more differentiated application by social and individual users of latest findings, experiences and technical solutions but

also of such that have already been accumulated cannot be separated from scientific and technical progress.

As recently as 100 years ago the information flow between science, technology and production was still rather tough and poor. Today, however, we have to deal with enormous information flows whose processing is costly and complicated. Their misdirection can result in tremendous losses for society, e. g. because of double work in research and development, or of false investments.

These information growth comprise the perfection and the improved utilization of existing findings, results, experiences and technical solutions as well as qualitatively new findings and laws with far-reaching consequences, which often cannot immediately be recognized, for different spheres of social practice as a result of the scientific and technical revolution [3]. This fact also coins the basic structure of information requirements.

Nowadays, correct and up-to-date scientific and technical information is the daily bread not only of scientists and of the army of experts in research and development, construction, designing and the preparation of production. New groups of users have turned up. To supply managers with scientific and technical information is a matter of pressing necessity. Experiences have proved that incorrect or factually inadequate scientific and technical information, i. e. information which also with regard to its economic and social aspects has not been thought over carefully enough, may cause the manager to take wrong, often even portentous, decisions.

But it is not only new groups of individual users but also such of collective users that make their appearance. Even the information facilities themselves are becoming collective users: they need information in order to set up, maintain, extend and improve the information pools and the information services, guaranteeing in this way the effective exchange among each other and, simultaneously, a more efficient supply of their user with information.

All these factors make it necessary to attach greater attention in the future to problems connected with the information requirements.

In the following we have tried to explain some of the possible fields for investigation.

Methods for determining the information requirements

The requirements for scientific and technical information may be classified on the basis of different aspects. Depending on which structure the investigator has in mind he will apply different methods of investigation [4]. The structure to be used most frequently in this connection, will, no doubt, be the classification by subjects. On this basis the information requirements of chemists, physicists, machine builders, physicians etc. in the fields of chemistry or in any other of their special fields may be determined. A second aspect are the requirements according to certain kinds of primary sources, such as contributions to magazines, research and development reports, patents etc., depending on the groups of users. Other aspects are the fullness of the information, the form of its presentation, periodicity and terms within which the requirements are to be met.

Information practice has developed a series of methods for the operative determination of the individual information requirements.

One of them is the assessment by the users of the information services offered. The user will state or write in how far individual parts or the whole system of a certain means of information or the possibilites offered by a library or a retrieval system have been useful for him. Though this method will often be the most simple and important one for all those who render information services, it will lead to nothing but partial optimizations when we look upon more comprehensive relationships.

Another method is the analysis of the questions asked by users, and of the answers to these questions given by the information facility. The analysis serves to specify tasks. In doing so it is possible to classify the urgency of thematic information plans in accordance with planned individual questions.

These two methods enable us, at best, to extrapolate, at a given date, the future information requirements from the analysis of the past; however, current interest is concentrating on making precise statements about the future information requirements on the basis of the interaction between user and information facility in accordance with

the stage the processing of an information task has reached. For this purpose the information expert should participate in plan discussions, in the defence of tasks and results, and systematically interview users and directly cooperate in research teams.

Selective information distribution as a method of a purposeful exchange of information is especially promising. At the same time it permits an exact determination of requirements, since it makes possible via the feedback from the user a periodical definiton of the knowledge regardng the information requirements.

These methods have been elaborated and utilized in particular for the determination of requirements in the spheres of research, development, construction and teaching. For other groups of users, mainly managers, and for the broad information of innovators and of all those working in the field of rationalization, they are less appropriate and still insufficiently tested.

Apart from methods used for the operative determination of requirements, it is the investigation into the general laws governing the information requirements that have been in the centre of numerous publications [5]. For these investigations, different groups of users were interviewed and observed. Interesting in this context is, however, the occurrence of numerous repetitions and in general and insignificant increase in findings. In most cases the investigations have resulted in an empirical description of the groups of professions and functions that have developed historically and are mentioned as groups of users. Some investigations also deal with the level of qualification reached by the users.

The knowledge of the specific information requirements of these groups, of the sources and means of information preferred by them, of the frequency of the utilization of information facilities in dependence of their positions, years of servce, qualifications, subjects of work and functions is still rather general. The conclusive statement is often very laconic and boils down to the fact that the existing information services are not utilized to capacity.

So far these theoretical investigations did not yield any results, that might be utilized in practice and that would exceed aspects already known to us through our daily work.

Necessity of a historical analysis of interaction between information yield and its utilization

In our opinion theoretical investigations into information requirements could be more fruitful, if more attention would be paid to the interaction between users and information yield as a historical process. The historical development of the production relations and the productive forces of society, the increase in the degree of socialization of work, the specialization and cooperation in science and production have steadily changed both, the information yield and the information requirements. In the course of this process the contradictions between yield and requirements became so acute sometimes that the continuation of the old methods implied unsurmountable information barriers. The contradictions were eliminated only after qualitatively new information pools and services had developed «spontaneously».

Such qualitative jumps include, for instance, the written fixation of new social knowledge, its extensive distribution by means of printing, the appearance of journals, the appearance of abstracting services etc. Referring back to ideas expressed by J. D. BERNAL [6], we have tried to roughly outline first ideas in that direction.

One aspect is obvious: higher forms of an exchange of information do never replace lower ones but supplement them. Thus direct communication is even now an extraordinarily important form. In primeral society it had been the only one. The emegrence of abstracts journals does by no means imply that journals are entirely superfluous today, etc. At present all these forms are united in modern integrated information systems. What has been said above will also apply here: automated retrieval does not replace older methods but supplements them.

In the historical process, however, shifts are taking place with regard to the proportions between the individual forms. In this connection nothing very concrete has been known so far. A thorough analysis by means of historical materialism should disclose important laws that govern the exchange of information.

Clarity with regard to history means greater security in the present and future development of information systems.

The actually available information yield exerts a decisive influence on the information requirements. It is the result of multifold scientific activities and reflects the relevant state of the cognition of the objective reality and its utilization in social practice. Under present conditions the information yield reflects a very complicated, multifariously organized structure of knowledge.

Aspects of the structural organization are: subjects fields, application fields, etc.; degree of cognition (ranging from plausible assumptions, hypotheses on theories, laws proved by experiments, to relationships that have been formulated on a strict mathematical basis), accuracy and reliability (ranging from descriptive statements, measured values which are difficult to reproduce, to natural constants which have thoroughly been proved in theory and practice), degree of organization (ranging from investigation protocols, contributions to magazines, research and development reports to encyclopedias, handbooks and data banks).

The user will continuously be confronted with this complicated information yield.

The more limited the task, the more fixed the information requirements

The degree of accuracy with which the information requirements can to be fixed will depend on how exactly the content of a task and the stages of its fulfilment can be defined in the plan. However, this will objectively depend on the place a given task is occupying in the cycle of science—technology—production.

It is, therefore, by no means appropriate to fix the tasks and stages in basic research which breaks new ground in the same way as is being done in applied research. When searching for unknown ordered relationships, for new subjects, processes and their properties in nature and society it is often nothing but promising directions of research and very often only weakly defined, ideas, techniques of solution and methods — or none at all — that can be given. It occurs very often that during the following processing step unexpected possibilities turn up that make it desirable to change the objective on principle [3].
This implies, of course, a more difficult prediction of the

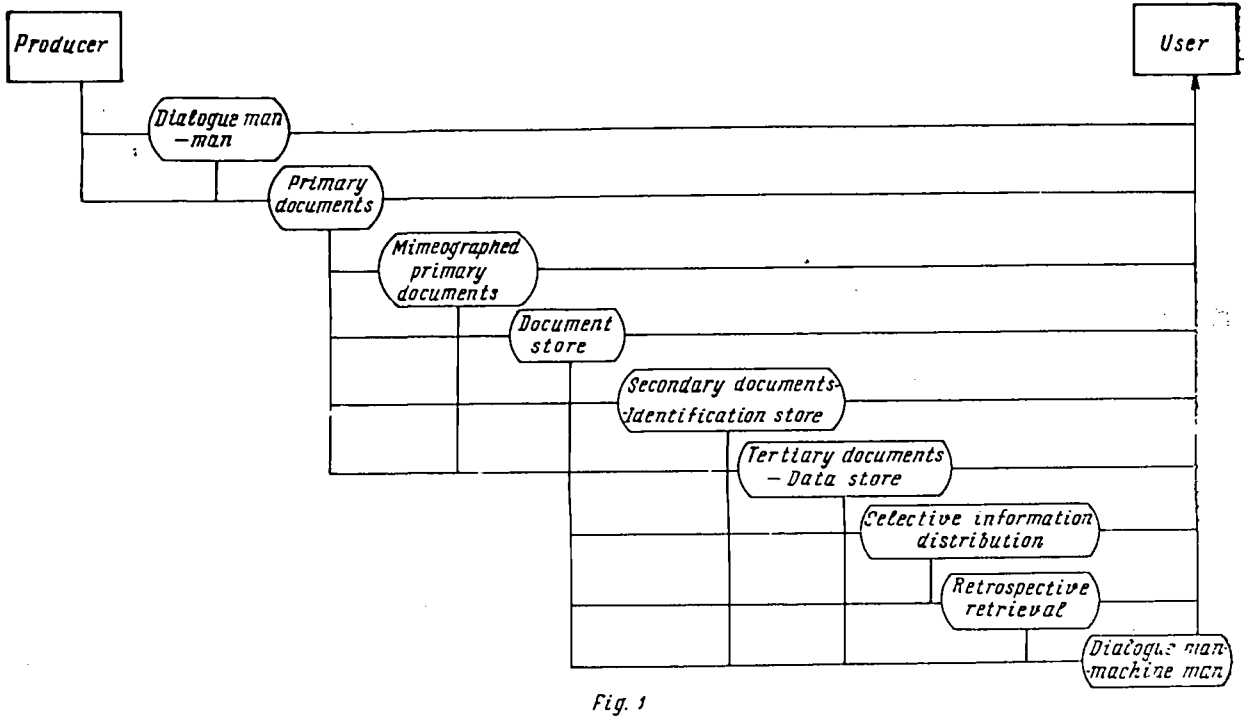

Fig. 1

Information pools and services (exchanged) between producers and users of information

information requirements — the probability of this prediction coming true is only very poor. In the course of his activities the research worker will often have correct himself. That is why the information expert is under the impression that the research worker does not know what he actually wants. But in reality these are necessary corrections. These information requirements are so indetermined and dynamic that others will find it hard to meet them. This does not mean that the research worker is no active user of the information facilities. However, in most cases he utilizes their information pools and information services on his own initiative (e. g. abstracts journals, catalogues, periodicals rooms, loaning of books etc.); it is only now and then that he will charge the information facility with tasks of a more complicated nature, e. g. the preparation of a complete literature searching in order to check his own work in this field.

The more we approach production in the cycle of science—technology—production, the better can the tasks and the stages of their fulfilment be planned because of technical reasons and the better must they be planned because of economic reasons. That is why, as a rule, the information requirements can be predicted with ever greater accuracy and reliability in basic research, applied research, development, construction and design as well as in technology. In the same sequence it is necessary to meet these requirements within shorter and shorter periods. There is an increasing demand for details. The requirements also tend to refer to a greater variety of subjects. As to the information required the emphasis is shifting from the unknown to the known because, to a growing degree, only incidental knowledge gaps must be filled. Thus, the possibility of formulating information tasks and, on principle, of delegating them upon others increase.

Fig. 1 shows a selection of typical information tasks which depend on the uncertainty of their objective.

Need for information as driving force

Information pools and services will become effective only if they are integrated into the active and creative

activity of man. Man, his work and the development of personalities and of their needs play, therefore, a decisive rôle in the development of the information requirements. «Just as the working man should feel, in general, the practical need to dominate the things in the world, so he should feel the general theoretical need, to abtain a systematic view of them.»*

Such basic social needs, e. g. the need to do creative work, the need for knowledge and self-knowledge, basically determine the information requirements.

1. In connection with the need to do creative work it is necessary:

— to have a most favourable access to specific and to general, understandable and reliable information from current international knowledge when solving tasks in accordance with the relevant working process;

— to eliminate recurring information handling processes and unintentional interruptions during the information process;

— to stimulate creativity through an organization of information that will support thinking in terms of processes and relationships.

2. In connection with the need for knowledge and self-knowledge it is necessary to guarantee more and more:

— the imparting of scientific insights and latest findings regarding the development of nature and society through classified, condensed and easy-to-understand knowledge;

— the acquisition of basic knowledge, of working and learning methods as well as of techniques for solving problems, of social experiences and optimum behaviour patterns allowing a strict self-control;

— permanent learning as a unity of work, education and personality development.

3. In connection with the need to belong to a community and to work within this community it is necessary to gradually bring about:

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* V. I. Lenin «Bemerkungen in Dietzgens Buch «Kleinere philosophische Schriften» Werke Bd. 38. S. 406, Dietz Verlag Berlin, 1968

— rational forms and methods of conveying one's own ideas, the results of one's work and similar things in order to have them included into society's store of knowledge;

— the effective examination, explanation, utilization and perfection of one's own intellectual products in short cycles with a high degree of the objectivity related to it;

— an active access to the current intellectual wealth of society with a view to increasing the degree of socialization of intellectual and creative processes, to expanding the intellectual wealth and to accelerating its utilization by society.

The transformation of information requirements into practical information gaining is a complicated process, since man's striving for the acquisition of information on the subject of his information requirements and his social dependence upon this subject are clashing. It is within the framework of this dialectical process that

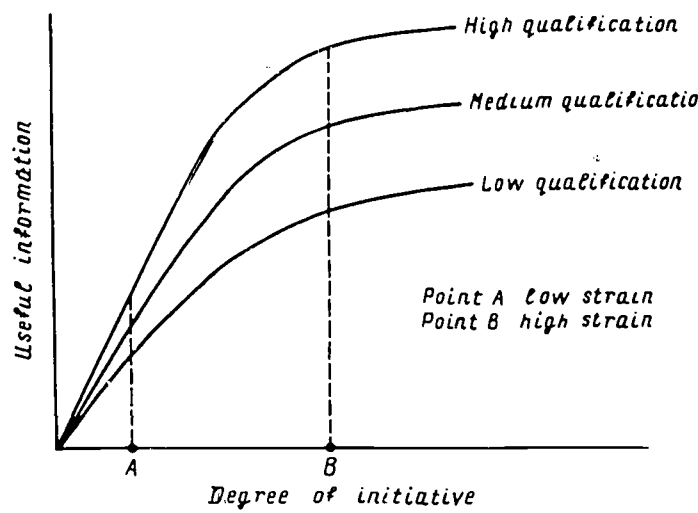

Fig. 2

Activation and gaining of useful information in accordance with the initiative and qualification of the problem solver

the initiative of the personality to obtain information is developing and that his information requirements are determined and met. This initiative will be the greater, the more the need, the will-power and the consciousness of the personality concerned are developed.

The higher the educational level of a user, the higher his task-oriented qualification and the richer his experiences to deal with a given task, the easier it will be for him — on the assumption of a certain initiative — to quickly obtain information which is useful for the fulfilment of his task [7].

Fig. 2 qualitatively shows these relationships. Point A corresponds to a small initiative (the staff members concerned fulfils his duties rather slowly) and point B corresponds to a great initiative (staff member is pressing things on). Beyond B overstraining begins: the objective conditions to inform oneself are exhausted. However hard one may try, the stock of useful information will not increase.

Scientific working process, problem solving and information requirements

In the scientific working process and in the person who is solving problems practically all subjective and objective factors are flowing together. The complicated relationships of the scientific working process, the laws governing this process and its critical aspects as to the information requirements have been investigated to a very limited scale only. We, too, can mention only some of the aspects wo consider to be important.

In a scientific working process a problem situation will arise when the processor realizes certain contradictions. As a rule, problem solving covers several stages, and only in the most simple cases problems are solved straight away. The recognition of the contradiction at a given stage of problem solving, which depends on the level of the initiative, will also determine the clarity of the formulation of the information requirements.

Any problem situation may simply bo described as the sum of statements either proved or not yet confirmed, or only assumed. This applies to objectives, actual situations and methods and means of problem solving. In order to

solve the contradictions between known and unknown things the processor will usually combine processes of thinking, learning, searching and problems solving himself, or he will control them or charge others with them.

For clarification the following three basic problem situations arising in physical research may be mentioned:*

1. In the course of research work a contradiction appears between the known theory, on the one hand, and measuring results or new effects found through experiments, on the other. The theory must be extended. In order to do that it is necessary to find out whether suitable methods — in particular mathematical methods — have already been described in literature.

2. Measuring results are either not exact enough or they are scattering to a non-justifiable degree. Therefore, they do not allow the corroboration of one or the other hypothesis. Improved measurements call for improved measuring techniques. It is necessary to find out whether relevant measuring techniques or instruments used in other connections have already been described in literature.

3. A physical effect is used for solving a practical task. It is necessary to find out whether similar difficulties to those connected with this task have been encountered in other fields, and to examine whether they can be eliminated by using the individual solution.

Continuous change of information requirements during the working process

It is well known that the solution of any contradiction will cause new problems in research and, thus, also changes in the information requirements. In order to adjust the profile of his information requirements to the new needs the processor has to check his information balance during the whole working process.

Thanks to his training and experiences the problem solver disposes of a large reservoir of means and methods he may utilize in gaining information, ranging from his own thinking to the carrying out of experiments, calculations and the simulation by means of electronic data pro-

* Here I am indebted to Dr. Winde

cessing. In general he will make the best and quickest progress if, first of all, he assumes that his problem has already been solved, and tries to find the relevant information.

More or less consciously and with good reason he will decide in favour of one or the other method of information gaining i. e. he will:

— activate his own knowledge;
— scan his personal store, his reference library;
— deliberate with his team;
— study textbooks and handbooks as well as monographs dealing with the problems concerned, and check sources quoted there;
— submit his question to an information facility;
— make use of information services offered;
— scan stores of an information facility;
— go for business trips, participate in meetings etc.;
— wait for information submitted to him now and then.

A good problem solver working in a team with a suitable composition is, no doubt, distinguished for his ability to answer a great deal of the permanently arising questions himself; but still quite a number of questions remain unsolved.

Many investigations indicate, however, that only a small percentage of these open questions that are of such a nature that they might be answered by an information facility, is actually submitted there. In VEB Leuna—Werke for instance, only one tenth of such questions in submitted to the information facility. As to data gaining similar conclusions were drawn at the CODATA meeting of 1972 in Le Creusot: only 2 per cent of the engineers submit their questions to relevant facilities; 88 per cent rely on values they get from colleagues working in the same enterprise, and 10 per cent rely on values they get from colleagues working in other institutions. Even if for different reasons these data should be controversial with regard to the proportions given, they show that information pools and services are used to a far smaller extent than is actually possible and effective.

We see the main reason for this phenomenon in the fact that the present state of development in scientific and technical information excludes the possibility to res-

pond to each individual requirement and its continuous change during the working process; this will hold true also for the near future. It is, therefore, typical of the individual user to select from the wealth of information that is a more or less of interest to him, only such information which — in view of his actual requirements — seems to be most suitable, and to store it either in his mind or at his workplace so as to be available at any time.

What kind of information gaining a user will prefer, depends mainly on the stage of the scientific working process in which he is engaged. Today the utilization of information services, in particular of primary sources, concentrates mostly on the beginning and the end of scientific work. It is, therefore, quite natural that the planned practical activities of information experts are focussed on these stages.

Experiences have shown that the handling of information tasks which are related to tasks, phases and stages of the research and development process will be especially successful if considered as the common cause of user and information facility. The profile of the user's requirements forms the starting point for an information cycle which covers the document searching, the assessment of its results, the supply of documents as well as the evaluation of the documents by the user. A poor definition of the requirmeent profile but also inaccuracies resulting from the indexing of documents and iquiries and from comparisons will, in practce, often lead to a limited identity of the results gained by different information experts, and their evaluation by the users [8].

This is especially striking at the end of the chain when the user selects the individual, applicable passages quoted in the documents. Fig. 1 shows that a great deal of irrelevant information will be supplied if there is no feedback between user and information facility. This does not apply in case the inquiries are fully determined.

Positive countermeasures that have proved a succes in practical life are the cooperation of information experts in research teams, the up-dating of the requirement profiles adjusted every three months, and the feedback during the selective information distribution, provided they are supplemented by a thorough and quick supply of the documents.

Make information activities more efficient for both society and user!

According to what has been said above the dominating method applied by users for information gaining will change only gradually. This requires to consciously change the present objectively necessary separation into information activities on the part of the users themselves and those on the part of the information facilities. The social concern in this connection is quantitatively to limit — on the basis of all information available — the quantity of information per user to such an extent that he will be in a position to select, in line with his social task and with the situation of his work, the most suitable information and to utilize it successfully. It is obvious that the high selectivity of the range of information required in this connection — its order of magnitude is between 10^{-4} and 10^{-6} — cannot be achieved with one single stage. In view of this fact it is necessary to set up special user groups, whose supply can be guaranteed with today's modern technical means. When considered from this angle three kinds of information requirements and adjusted methods of determination should be given priority in the development and operation of information systems.

1. Requirements of low dynamics, low selectivity and stability.

The general information requirements are related to the necessity of obtaining all valuable findings available so far, of consolidating the homogeneity of science under the conditions of specialization, and of creating the prerequisites to a high profitability of information work. The structure of these information requirements is predominantly determined by the structures of science, of the professions and functions in the social reproduction process, which have developed historically and will be stable for a long period of time, and by the degree of organization of the given information system.

Regarding the scope and the uniformity of the acquisition and of the subject-oriented evaluation and classification of the international information yield the information pools and services of the VINITI in the USSR and the international information system being developed by

the CMEA countries constitute the functional prototype designed to meet these information requirements. The endeavours of INIS and UNISIST are becoming effective in this direction, as well. The relatively slow changes of these requirements may be met in the usual way through the offer of and the demand for information services. A main method for the determination of the requirements is the analysis of how the users respond to means of information.

2. Requirements of medium dynamics, medium to high selectivity and stability.

In the cycle of science-technology-production numerous scientific and technical tasks are emerging which involve information requirements of a high specificity and often covering many different subjects. The great differences among the users regarding subject, intended use, terms and presentation forms of information rule out any theoretical formation of user groups. It is most likely that the formation of groups — a prerequisite to a more efficient supply with information — will be possible on the basis of an analysis of the flow of inquiries [9]. The same attention which is attached to the preparation of the information yield should therefore be attached to the preparation, filtration and grouping of this flow of inquiries according to content and time, to quality and quantity. Thus, specific and requirement-oriented information services — as, for instance, selective information distribution facilities can be efficient; information services which may easily be handled by the user and are time-saving, which constitute a favourable compromise between the expenditure of the information facility and the users' own expenditures.

In this way the requirements for high-quality information services (analytical surveys, compilations of data and facts, progress reports, international comparisons) will be put on a stronger basis. This would permit a better adjustment of the preparation of such costly information services to the requirements because so far this preparation has been depending almost exclusively on the development of the information yield.

3. Requirements of highest dynamics, highest selectivity and lowest stability.

While the information requirements continuously emer-

ging during the scientific working process are such a dynamic and short-lived quantity, the information services are still so sluggish today that they can be utilized and charged with the solution of tasks only in special phases and sections of the working process. In research institutions, which are working well, these most suitable phases and sections will, in general, be found only through close teamwork between research workers and information experts. That is why the cooperation of information experts in research teams is of great importance, not only because they help ensure a better operative supply with information but also because they pass on methodical experiences in determining information requirements. In connection with the rationalization of creative activities and in view of an increasing automation of recurrent information gaining processes the determination and meeting of the information requirements, which are directly depending on the user's working process, are approaching the sphere of reality. The user must have direct access to scientific and technical information, he needs the dialogue with the information pool. In this process which is controlled by the user his needs for information exert the most direct influence during the working process, i. e. during the fixation of the information requirements.

In view of the high expenditure, in particular with regard to the necessary, profound preparation of information — which should index complex relations as well as individual details and ensure that they can easily be retrieved by means of a computer — this form of interaction between user and information pool will, for the time being, remain restricted to a few most significant points.

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In modern integrated information systems these three kinds of information requirements, of the determination of requirements and of the means available to meet them are closely connected with each other. The efficiency of scientific information activities performed by the users and by information facilities will, therefore, increase more quickly if these relationships are consciously recognized and taken into consideration during planning. Whereas according to points 1 and 2 the requirements are, in

principle, aiming at more and more effective networks of acquisition, production and distribution of scientific and technical information, which will supply the users with quite useful, flexible and economically optimized information services on an industrial scale, the requirements according to point 3 correspond, in a embryonic form, to an active and dynamic network which can be developed only on the basis of 1 and 2 and which could enable the user to directly couple and create an organic connection between utilization and production of scientific and technical information in the framework of the individual working process and in the framework of the whole of society.

Some of the typical information tasks emerging during the scientific working process

Degree of uncertainty	Description of the task	Frequency of occurrence of the task
Highly indetermined	Search for new ideas, objectives. For this purpose, scanning of a variety of sources and means of information to find out subjects, methods and analogies though the problem solver has only very vague ideas about them and does not even know where to find them	sometimes, spare—time supplementary activities
	Search for new kinds of associations during the preparatory stage of a scientific task; the ideas about the characteristic features and directions of the search are still very vague	sometimes, more concentrated during the preparatory stage
	Search for new directions of development, new subjects, methods and procedures for concrete branches of science and production through complete literature searching and the analytical and synthetical processing of the results	once every three to five years with annual supplementation
	Search for the international comparisons when preparing complex tasks through complete literature searching and analysis (critical surveys)	once every two to three years with a supplementation every six months

Degree of uncertainty	Description of the task	Frequency of occurrence of the task
	state, and elaboration of interna-	
	Ditto with limitation to individual subjects	»
	Search for information to check one's own results and ideas	in most cases at the end of scientific work
	Search for new application fields one's own results	»
	Keeping up with latest developments regarding a given task	monthly
	Keeping up with latest developments regarding given subjects and themes	monthly up to every six months
	Acquisition of knowledge regarding a related field by means of one or several valuable publications	sometimes
	Search for unknown properties of known subjects, methods etc.	several times a week
	Recollection of properties of known subjects, methods etc. which had been forgotten (Filling up of knowledke gaps)	several times a day
	Procurement and utilization of publications that have been quoted	»

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D. Vidovič
(YUGOSLAVIA)

REFLECTIONS ON THE RELATIONSHIP BETWEEN USER AND INFORMATION WORKERS

The problems of development of collections of documents and of relationship of information workers with the users of information services are always present and become more acute.

The collections of documents were started very early, in times when it was almost possible to assemble at one place all the written knowledge. This knowledge was general and developed as encyclopaedical one during many centuries. As a consequence of such a development, nowadays many libraries and information centres find themselves in position to rethink their relationship with users in such key questions as are the coverage and treatment of material in their collections. Very often, the depth and selectiveness of coverage, as well as the treatment of documents, by such institutions do not answer more the needs of a growing information demand. Sometimes an important part of their collections, owing to the change in quality of the newly produced documents, is devoid of new knowledge or bears it in negligible quantities. Some writers on the topic estimate that between 50 and 90 per cent of new documents claimed to be of research of technological nature bring to their users nothing or little new, be that a fact, a new statement of a problem of a new set of ideas. This phenomenon, of the existence of a flood of newly published materials of little information value, raises in a new way the question of who is to bear responsibility of coping with this problem and to solve it in the most efficient way.

So, the most serious problem in the field of information is now to establish and develop a collection of docu-

ments: it must be complete to a reasonable point, its documents treated so to be accessible almost instantaneously, the collections themselves not burdened by unnecessary materials. To fulfill these requirements, collections are to encompass by their coverage just their area of knowledge, precisely limited, so to become neither too poor nor wastefully wide. It is a very hard task to define and keep these limitations of the depth of coverage, a longterm task which is normally to be solved by a highly professional layer of people working inside libraries/information centres. The more so, as information services are usually burdened with more or less of noise, what arises partly from inadequate treatment of documents in the stage of their preparation and organization for use. In a collection documents are not only to be selected and assembled with the knowledge of problems they cover, they are also to be adequately treated for use, to become accessible to users quickly and in an efficient way.

As the history of information work shows, projects to assemble in one place the whole knowledge never succeeded, and the current latent crisis of large libraries/information centres, those with a wide coverage, can only be overcome by developing institutions in the field of information with more specific coverage and service. It was found that large institutions pay heavily for having extensive collections of little-used material in their premises. Bradford's law of scattering, a law of diminishing returns with respect to the growth of collections size, is highly relevant to the planning of institutions in the field of information, to the organization of their current awareness service for users. The existing systems of library services still reflect the old cultural pattern in which general libraries preserve documents in the domain of literature, history, arts, classical studies — while research collections in the areas of science an technology are developed by specialist research institutions, faculties, research centres. For the needs of the users in this latter group there were started in the 19th century special libraries, as centres for an advanced treatmet of sources. This idea of specialized collections developed and ripened further in this century and became an almost common reality, the one which leads towards a deeper maturing of the subject concept in information science. In France,

there was in 1968 especially stressed by a commission the rôle of specialized information centres with an accent on satisfying the needs of industry. Discussions of the problem during the sixties led in the USA to an understanding that the best answer to the needs in informaion are information centres operated on a decentralized basis. During the recent years started, in the UK, the development of Specialized Information Centres (SICs), imagined as a filter for the evaluation of literature by working scientists, which, it is thought, may become a connection between the abstracting information services, separate users and research institutions.

Planning and development of information institutions of every kind requires an adequate solution of the problem of acquisition and treatment of material. It is quite normal that immediate users have a say in decisions concerning the acquisition policy, but it is also quite clear that they are burdened with work and often are not able to build systematically a collection of sources. There is much agreement on how a collection is to be built, what materials are to be expected there, but there is a comparative lack of not only agreement but of discussion also of the problem who precisely are those on whose shoulders the task of the building of collections rests. The rôle of the makers of a collection, the composition of these bodies and their required competences, are not sufficiently illuminated in the writing, and decisions in this direction do not always stay on theoretically based opinions.

And the problem is clear: in contemporary libraries/ /information centres there is the place for people capable of assembling, adequate treatment of sources, and of building usable information tools. Though a trend exists among librarians to discuss generally the form and content of publications that come in their collections, one feels that of small use is the knowledge that, for example, in primary sciences researchers are able to satisty their needs in information using 9 per cent of the existing periodicals titles unless we know what particular titles and areas of science and technology are in question, and for what span of time. The same is the case with the information tools. Catalogues often constitute a formidable barrier for the user and are not a key to librarys' content. Many readily confess that so little has been done to exp-

lore the real nature of the difficulties catalogues present to users to find out something best suited for them: librarians/information workers must be more interested in this question as some users are of mind that the former tailor catalogues after their, and not their users'needs.

All these previously mentioned problems are not questions of good will, they are something arising from the lack of a sufficient command of the subject fields by those engaged in libraries/information centres. So, information services often remain underused because imperfect information tools are baffling to users. These tools are not, of cource, organized more for the convenience of the staffs, but the knowledge these tools are supposed to make accessible to users is not always organized and offered through these tools by persons who understand the subject matter they work in. And many users know how it is very difficult to obtain data in a field outside one's own subject field.

The need of building the internal tools to make use more profitable is nowadays, despite the existence of indexing and abstracting journals, becoming more pressing than before. Abstracting journals usually come lately, and they are not without other deficiencies, and the similar is the case with more general indexing publications. Sometimes these journals suffer in their coordinate indexing from the incapacity or negligence of a part of authors to express the content of their papers in the title.

Indexing journals of particular libraries/information centres, which are growing in number in the recent time, usually are more precisely geared to the needs of their immediate users and they can reach them always in time. If their compilers know their job, and approach it qualitatively and not in terms of quantity, such publications normally become an important information tool for users. The same goes for various other tools for making users currently aware of the possibilities of service oppened to them: the contents lists, lists of acquisition etc. Almost all there depends on the knowledge of the subject field being covered, and only a fraction of success in such ventures depends on other conditions as technical skill of librarian/information worker of descriptions of the behaviour of users are. Abstracting journals being more on the side of retrospective information, the preparation

of internal tools of current awareness becomes a very important task of information workers. And he is to approach the needs of users in a most concrete and specific way. Even with a constant betterment of information brought in secondary and tertiary publications many day-to-day needs of users in information cannot be satisfied save by the work of information cadres strongly backed by their own knowledge of the subject of information. These information workers are normally expected to supply specific information prepared in their library/information service, and that is only possible by investing creative work in their subject fields. The old times of describing the outer apparatus of publications have gone for good: the present information worker has not only to build systematically and with competence collections of documents, he is normally expected to prepare collections and information tools to meet the needs of users, to become reliable information processor and searcher in his subject field. Historical reasons and professional interests blur the picture and contribute the work of those engaged in the information field today to be sometimes interpreted emotionally which makes difficult a rational approach to the problem, though we are at the thres hold of the 21st century. Little notice has been taken of the fact that in the past the posts of librarians/information workers were usually kept by scientists and that it is such people who are only capable to answer best today's requirements of making and running a collection of documents.

The rôle of librarian/information worker does not exaust with his power to influence the user before the latter expresses his demand. It is not without reason that, in a large part, surveys of users behaviour tell little about the assistance users ask or obtain from information workers. In her article for the «British Librarianship and Information Science 1966—8 1970», M. Slater cites only one example in which the information worker was successful in his work with students and ascribes that fact to his being a specialist in the subject field in which he worked. One gets the impression that some librarians avoid this problem instead of trying to elucidate it in the highest measure possible. In a substantial number of research, industrial, and technical libraries this need for engaging subject specialists in the leading positions has

long been recognized, and the idea is now creeping into the practice of other libraries/information centres, which is the best proof of their modern orientation. This enlightened policy has been substantiated in various ways in the libraries of the new British universities established in the sixties. They became strongly disposed to give scope to senior staff who would be recognized subject specialists, and whose work would include cataloguing and classifying in their subject areas. Some librarians met this practice with grumblings, claiming that it was wasteful because a large number of subjects was to be catered for and the libraries with such practice, allegedly, started paying penalty of — being more accessible. One must remain appalled at such attitudes because higher professional competence is always more productive than the lesser on provided the work is well organized. Everywhere, the economy based on the low pay is bound to become a disaster and is not the example to follow. These new libraries undertook the creation of posts of subject specialists exactly out of desire to improve quality and range of services to users. Certainly, they engaged themselves in the introduction of users into the use of library tools and resources, in what did so much the brilliantly led NLLUK, but this was never their main goal: their intention was to take part in the acquisition work also. Many recognize that the main achievement of this endeavour lies in the quality of the provision and service offered to their users. These libraries became involved in more work for undergraduates and extended their obligations into the field of instruction: sometimes they found themselves ahead of the teaching staffs. They found themselves more intimately involved with course planning and the research activities of their academic colleagues. These libraries have gone some way towards combining the independance of acquisition programmes, in the tradition of university libraries of Oxford and Cambridge, with a high degree of academic involvement, cooperation, and responsibility. In one word, their leading specialists started to take part in a real division of labour among specialists of their universities in the areas of teaching, research, and information provision. They proved what was many times claimed by their advanced colleagues or members of the research community that it would be

absurd to pretend that scientifically trained personnel are not, in general, more suited to information work than others. In more developed libraries/information centres a general librarian is merely a keeper of books and periodicals. And such a custodianship has a diminishing meaning in an epoch in which the task is not to preserve rare printed material, but to select what is valuable from a flood of printed paper. The future is with the subject specialists who decide to work in libraries/information centres and who only can, in close cooperation with their users, to build collections of documents and to work in an atmosphere of a real division of labour in the field of every discipline of knowledge.

As for the users, the only thing all are in agreement upon is that they are, by their nature, not a homogeneous group: besides researchers there come administrators, managers, politicians, education, defence etc. In the very stratum of researchers there exist side by side groups engaged in basic studies, in applied science, technology, and other fields. Then, there exists a kind of bipolarity: some people there are active in their subject and other in various jobs, and this division is different in every particular field of knowledge. Studies of users behavior undertaken by some libraries/information centres have rendered results of little general value and only rarely they adapt themselves to use in systems analysis. It was the consequence of the approach to these surveys that they were almost condemned to give poor results. The approach was often formalistic and got not deeper into the heart of the problem. Overconcentration on a faithful account of the surface obscured what was lying underneath. Users in these surveys are often taken as statistical units, and their relationship with librarians/information workers is rarely given full attention. Between these two professions, i. e. researchers and informationists, there is a more serious connection than a sheer mechanical relationship, and their activity in the area of information procurement are so interwoven that it is almost impossible to study the problem of users in full separation from the activity of informationists. Judging from the information on the users surveys, as they are reported in the literature, it seems that, despite all the effort invested in the exploration of the problem, only modest results were

obtained. Some of them brought conclusions clearly of small use beyond the limits of the organisations they were undertaken by. Their main insufficiency lies in their tackling the problem in separation from the rôle of librarian/information worker. Somehow, the questionnaires used in these explorations reduced users to passive objects of study, and one is only to hope that the same would not take place with the undertaking of the LIBER, the League of European Research Libraries, which has decided to investigate the problem of users in a project led by Mr. R. Escarpit, from the Bordeaux University.

M. Slater stresses in her article that in the UK most of the users surveys undertaken dealt with the needs, demands, and habits of specific users groups. The results obtained from the surveys mainly confirmed things one good information worker must had guessed in advance, with great degree of certainty, from his own experience. One survey established that students are the largest single group of users in public libraries, and another found that in technical libraries books are used by 56 per cent, periodicals by 43 per cent, and indexes by 22 per cent. One learns further that in a library two-fifths of material borrowed were monographs, and in another library, in West Germany, only 10 of 890 journals were frequently read by more than 50 per cent of lecturers. One survey concludes that users in industrial libraries tend to be highly dependent on the resources of their own library and on personal contacts, and that for 41 per cent of engineers/users in the USA the speed of service was not essential.

Findings stressing the importance of personal contacts of researchers or of their attendance to conferences and meetings are interesting but we cannot draw any profit from the conclusions that users need some time to adapt to a newly computerized system of information retrieval or that some users turn in substantial numbers to abstracting services while others do not. One is tempted to agree with a librarian, who writes in the mentioned collective review of the British librarianship, that librarianship sometimes gets his priorities wrong, spending the main effort on the perfection of long-existing techniques and in updating 19th century traditions. But this is not to say that the solution of the problem of users is

impossible. What is needed is a correct methodology, as in the work of the American researcher of the problem, T. Allen. He chose the sociometric methodology in his study of the problem of users, and one can hope a promising way has been found for the future work on the problem. Allen investigated the bahaviour of users in the USA and he undertook to illuminate the internal interactions of the scientific group. He found that results of small research teams do not necessarily depend on the quantity of literature searched. The so-called reading habits of researchers, thus, may not be the main problem for informationists. Allen introduced in the field of users study the concept of leadership in information. He established that there act the ones who have wide interests, beyond the subject or job specification, on whose rôle of informants rely other members of the team. In other words, T. Allen established that these informant/researchers act in a large measure as the ones who satisfy the needs in information of researchers, which is normally the task of professional information workers. So, an unofficial division of labour existed already in the midst of the research groups. This is a serious proof of the fact that users are in the same time generators and propagators of information. They have an active rôle in this direction, the one which is inseparable from their «passive» rôle of clients in the institutions for information procurement. M. Slater is therefore right when she dwells long on the study of T. Allen in her mentioned article.

T Allen's findings are in some sense confirmed and developed further in the findings of those who wrote the analysis on the possiblity of establishing the UNISIST. Their text confirms that the problem of user normally begins with the group he is attached to and with the collection he relies upon for information. The UNISIST program discusses the problem of the highest forms of documents and data analysis and takes the view that this funstion requires nowadays research, which is true not only of review information but, also, of compilations of critically evaluted data. There is added that in the «knowledge organization» there tends to remain less difference between these intellectual operations and the preparation of an original paper. The same is the case when an information worker prepares data tables or review articles

in an area of knowledge. Scientists tend more and more to establich centers, of the type of the British SICs or similar, for evaluation of data and documents in whose a part of their effectives will have to engage. In the circles of the UNISIST project, there have somehow formed the view that documentalists, information workers, and librarians can be used in information dissemination, but, that without the engagement of researchers, it would not be possible to develop the activity in areas of analysis and synthesis of information. This task, it is claimed there, tends to remain with researchers while the transfer of information, where deep understanding of content is not necessary, can remain on the shoulders of information workers. In other words, neither to T. Allen nor to the UNISIST group, there is nothing strange in the idea researchers to take the fundamental part of the information activity in their own hands in a division of labour: partly between them and partly with subject specialists who are not researchers. This seems to be a sound solution for which there ought to find only resources and economic ways.

Some of these reflections may become less pessimistic in the future, but it seems clear that the foundation of the information service of today and tomorrow is to be subject oriented, based on a large number of subject collections developed by subject specialists. The highest forms of information work remain, as today, the domain of research and technological specialists of a higher rank: the users are in one respect the informants and vice versa. There is no other way to fight the flood of sources of various value, to treat them accordingly, and to secure a steady flow of information to the points it is needed, in quantities and in time of the need. That is why technical aspects of use are a second rate problem: information work is so serious an activity to be left entirely in the hands of those who are not the main users of the newly acquired knowledge.

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R. P. Vtcherashniy
(USSR)

INFORMATION SYSTEM AND ITS USERS
(A conception of the development of a State information system)

1. A great deal of articles and monographs were devoted to the problem of information requirements research. But even at present there is a considerable gap between information systems capabilities and real needs of different groups of specialists. Such a contradiction in informatics is defined in many aspects by the changes taking place in the structure of economy. As concerns the changes taking place in the structure of economy. As concerns the activity in the field of information, these contradictions relate not only to the changes of the structure of national production and corresponding restrictions, but rather to a non-comprehention of reasons of the present crisis. One of the main reasons is the fact that the information requirements research is conducted out of touch with the research of trends of the development of production and creative processes, out of touch with the results of scientific analysis of the developing organizational structures of the socialist economy.

The processes of an ever increasing integration of different spheres of national production, implementation of automatic management systems for research, development, production and marketing taking place recently lead to the fact that information is transformed to a greater extent from a supplementary material to **means of communication and coordination of different spheres of the cycle «science — technology — production — consumption»**.

This should change the character of information requirements research in many aspects.

First, the conditions of compulsory use and processing of information are arising for many groups of specialists because intuitive methods of decision making would become worthless in the circumstances of modern production.

Second, the significance of those information characteristics which make possible its effective use for planning and forecasting purposes increases sharply.

Third, the information is assuming a more complex character both in vertical (within the cycle «science — technology — production — consumption») and in horizontal (connection with the information used in interfacing industries, information necessary for developing software complexes and so on).

Fourth, the period of use of information is narrowing rapidly in time that more often leads to a necessity of realtime information systems with a high level of information formalisation that allows to input it into computer systems.

Fifth, the rise of the organizational level of production and creative processes leads to a condition when at every step of national production the information is used continuously. Furthermore, the rhythm of its use should be closely connected with both the specific technology of a given process (the development of a new device) and the «vital activity» of the system as a whole (realization of certain directions of scientific and technological policy of an industry).

Thus, the necessity of «information technology» which provide a systems service both for separate steps of the creation of new implements of labour and technology and for a whole complex of requirements in a specific object-subject field.

A brief listing of changes mentioned above and taking place in the sphere of information is a rather expressive evidence of the fact that **the information requirements research with the use of statistical methods of interrogations and questionnaires is useful only for the estimating the conformity of a really existing system capacity and «today's» requirements of some groups of users which are not adequatly understood.** Moreover, the gap between the «need» and «possibility» would be always significant if the rapidly changing character of

information requirements, opportunities and responsibilities of existing information services in the enterprises and institutions, and communication ties between separate groups of specialists realized in a management system are not taken into account.

From the above, it is possible to make a conclusion that **the development of new information systems should be based upon the forecasts and simulation of information requirements both for advanced structures of national infrastructure as a whole.** Such a concept is rather trivial as it is known that the development of any scientific discipline (of sphere of national production) is determined by both general and internal laws. But the simulation of information systems, as a rule, is accomplished for the existing structure of production that inevitably lead to a lag in «the information technology».

2. What are the traditional requirements and real capabilities of a well organized information service?

Any cycle of material production could be examplified as a chain of basic steps through which a national product is moving from the moment of the appearance of a scientific and technical «idea» up to its material realization (see Fig. 1).

The first stage in the above mentioned cycle is the sphere of research and development (mainly theoretical) which predetermine and pave the way for quantitative changes in the sphere of technology.

The second stage is the sphere of applied research of which the main object is to «interpret» a theory into an engineering solution. At this stage, as a rule, the search is made for the spheres of application of new scientific knowledge, a certain multiplication of a scientific outcome.

The third stage is the sphere of constructing and designing. At this stage the search is made for the materialization of a scientific and technical solution taking into account the level of material production achieved. The peculiarity of this stage is in the fact that the constructor and designer while manipulating with known scientific and technical solutions use often principally new means of realization of an idea or new technology providing for a new quality from a known solution.

The fourth stage is the sphere of the industrial appli-

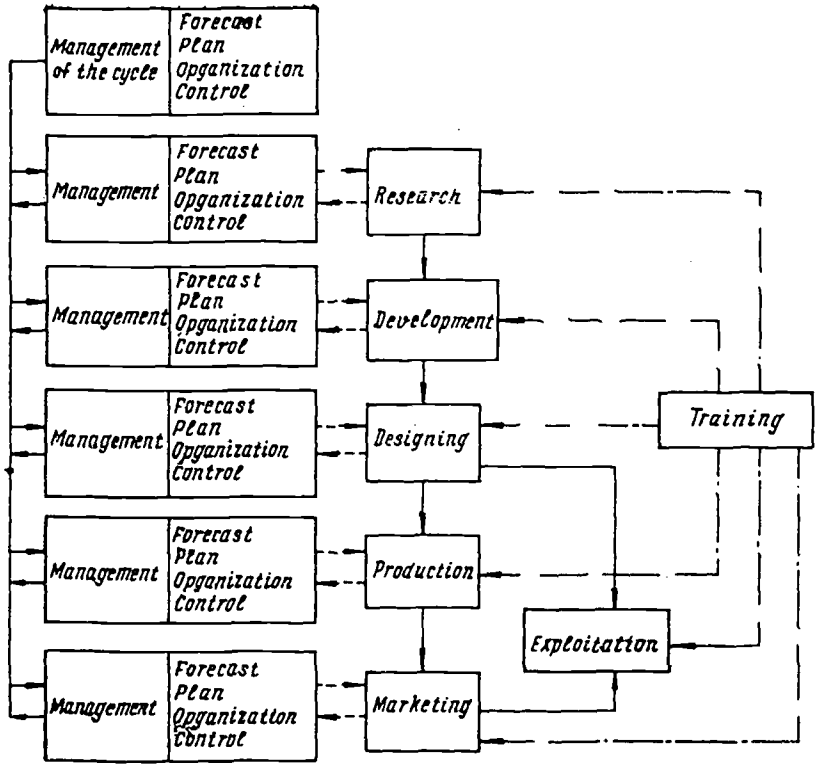

Fig. 1

Stages of national production

cation which has a dual character defined by the peculiarities of consumption of the national product. As it is known, the national product could be used by the society either for the production of means of production or for the production of objects of consumption. In the first instance, the national product remains in the sphere of production and in the second instance it goes to the sphere of consumption. In the sphere of production the national product undergoes quantitative changes, in general, related to its reproduction on an expanded scale. The cycle of that new information which is connected with the

creation and improvement of technology is also completed in the sphere of production.

Finally, the fifth stage is the sphere of consumption. This sphere of national production is rather diversified because it includes practically a part of the sphere of production with corresponding marketing system and system of inventory supply, and the sphere of personal consumption also with its corresponding marketing system and distribution nework for commodities. The peculiarity of this sphere is in the fact that it determines not only the necessity and efficiency of the national product but distates the dates of its creation too. It becomes apparent sufficiently when realizing consumers' goods and, to a lesser extent, when renovating fixed capital in industry.

In addition to the above mentioned main extended groups of users of information there is another very responsible user — the sphere of management. It is known that in the sphere of management material values are not produced. But just through management information is used for ensuring the normal functioning of the whole cycle, just through management and use of information the feedback is realised at the different stages of the national production, just through management the use of iformation is organized at present.

It is known that the functions of management include the forecasting of perspectives, current planning, organization of the process and its control.

Management is necessary for the cycle as a whole and for every stage. In the sheme (see Fig. 1) management organs are depicted as an independent link of the structure at every stage of the national production through which the use and exchahge of information are carried out. In this sense, the management links are the elements of an information infrastructure.

Finally, the infrastructure of personnel training or the sphere of education is a specific sphere of the use of information. But in connection with the special character of the use of information in the process of education (a high level of generalization, time lag which is inevitable for a verification of scientific facts and so on) it is not considered in this article. It should be noted that each of the above mentioned stages is directly connected not only with the preceeding and subsequent stage, but with other

stages of the cycle «vertically». In addition, «horizontal» interindustry ties with the corresponding stages of interfacing complexes and kinds of manufacture are becoming more close.

In order to elucidate the specific character of information requirements at every stage of the national production it is necessary to consider the examples of meeting «today's» information requirements of the specialists in national economy working at different levels of the national production.

These form will vary for various spheres of activity. In the sphere of management it is current and «situational» information that is of particular importance; in the sphere of scientific research — current information on new methods of research and new scientific equipment. In the sphere of construction and design. Work prime attention is paid ot current information of new R & D projects. In the sphere of production come to the fore current information on modernisation of the equipment manufactured, of production technology and operational experience. And last, in the sphere of marketing the user is bodly in need of express information on marketing.

What is the peculiarity of the reports given in the Appendix in contradistinction to a traditional reference bibliographical information produced by the All-Union and industry organs of information including the system of selective distribution?

The main feature of traditional reference bibliographical information including its SDI system consists of the fact that the information flow related to a specific group of users is kept aloof from the general information flow not in accordance with the subject-object characteristics (that are put, as a rule, into the systems of differential and selective distribution), but according to other qualitative criteria which define the peculiarities of using information at every level.

The second feature of this information is in the fact that **the user's information service** executes not only the functions of the communication channel between an information center and subscriber, but the functions of an **analyzing link** which transforms the current onformation into a **management decision used operatively at a specific sector** of national production. Out of the general flow

of the very diverse information only those messages should be selected that are needed to the user «today». They are those data that are used for making alternative decisions. In such a form the information is ready for use. This level of selecting and preparing the information reqires not formal but active participation of the information in this creative and productive process. In turn, the organ processing and distributing the information in a centralized way should take into account the possibility of analitical transformation of produced information.

The third conclusion that suggests itself consists of the fact that a every level of the national production both current and situational forecasting and analitical information is necessary. It is conditioned, first of all, by the increasing role of management at every stage of the cycle «science — technology — production — consumption».

The increasing role of management function has led to a necessity of ensuring the compatibility of the stages of the current scientific and production process and similar stages in future too. Therefore, the conception of the socalled scientific and technological information which is to serve as one of «the construction materials» **in organizing** the processes of the link «science — technology» is broadening rapidly «involving» the forecast, analytical, planning, economic and management information. The realization of these functions has lead to a necessity of not only the extensive broadening of the field of information but to an emergence of new connections and interactions with other kinds if information arising in the sphere of production and marketing. In other words, if earlier the information service of a research institute was interested only in the information on the subjects of researh and development then now it should be interested in the information necessary not only for forecasting the development of a given field of subjects, but for the analysis of the demand for new developments. Furthermore, these new kinds of information exert an ever increasing influence on the process of consumption and estimation of the scientific information itself. It means that in the conditions of the scientific and technological revolution the criteria of a qualitative appraisal of information are changing sufficiently: the scientific and technological

aspects of information retaining the dominating role are yielding to the factors of an economic and conjuncture appraisal.

It is known that the correlation of expenditures for basic research, applied research and industrial development coul be approximately estimated by the ratio 1 : 10 : : 100. In the industrially developed countries the expenditure for R&D is up to 3 per cent of GNP. It means that the realization of all the results of R&D in the economy is practically impossible. Therefore, the main task of the information service is to select and use the information which ensures a maximum (not only economic) efficiency for economy.

In summary it should be noted that the incompatibility between the central information agency and the user and, consequently, the basis for the so-called «information crisis» consists of the following:

— on the one hand, the existing information services of research institutions and industrial enterprises function not at the necessary analytical level; many sectors of economy have no information service while this function can not be accomplished by all-state centers; there is no perfect and recognized machinery for economic appraisal of scientific and technical solutions;

— on the other hand, the existing methods of a centralized information processing, while solving the problem of the most economical processing of current information, reduce to a greater extent the possibilities of its analytical processing by the user (by his information service; some information requirements are not met at all; the information issued by the corresponding centers is not differentiated according to main categories of users.

Of course, it does not mean that the organs shoult be abolished doing all the information flow processig in the corresponding services of enterprises. Evidently, the main way of overcoming the information crisis is in the consolidation and development of information service function of the user, in the development of economic appraisal methods of new scientific and technical solutions and methodology of their application at certain stages of national economy.

3. What are the exi ting information centers? To a

certain extent of conditionality it could be asserted that the functions of any information agencies and services are, in general, the following;

— the function of the depositary that is the function of storing the scientific and technical documentation and issuing the copies on the request (including via an inter-library subscription);

— the function of issuing a current information that is the function of transforming the current information with the aim of the unification and simplification of the methods of bringing it to the user;

— the reference function that is the function of issuing not only current but retrospective information too according to a specific operative demand;

— the function of the analytical transformation of information with purpose of providing information to the management.

Information agencies are also engaged in the dissemination scientific and technical innovations (the shortcomings of a current information system are to a certain extent compensated by this measure), in education and solution some other problems of a supplementary character (the development of methods of using technical means, information languages and so on).

Essentially, anyone of existing information agencies may be considered as an institution realizing a certain set of above mentioned functions, but with the different weight coefficients: in some institutions the function of current information is dominating (in the All-Union agencies), in others (in the industrial organs) — the analytical or reference function, in the thirds — (in the inter-industry territorial information centers) — the depositary function.

The building of national systems of scientific and technical information should be practically reduced to the determination of such weight coefficients. But the rating of these weight coefficients should be accomplished not within an information structure, but rather within the limits of the production structure taking into account the character of the economy planning.

4. The studies carried out in CNIIPI in 1967—1971 showed that the providing information for an «usual» cycle «science — technology — production — marketing» is

a complex scientific and technical process related to both a continuous generation of the ascending situational information (from a market or technologically assimilated level of production to an advanced scientific and technological level or plan of R&D) and a current information processing received from every stage of production and form the outside (or from other industries within the interindustry exchange) including very different sources.

The structure of this flow is quite different as the user's interest is biased from the sphere of R&D to the sphere of marketing. If the structure of information is represented on a diagram then in the movement to the end of the national production cycle the scientific and technical information would yield to the economic information (see Fig. 2).

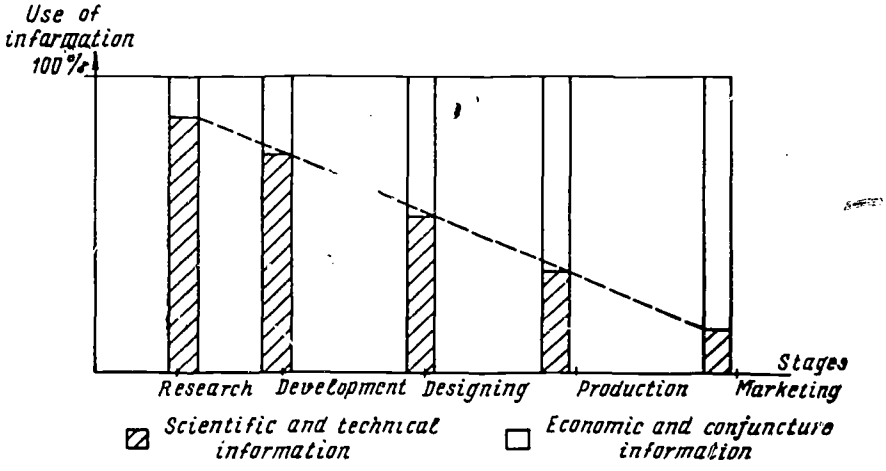

Fig 2

Change of qualitative characteristics of information used at different stages

The number of kinds of information used both in specific kinds — reports, descriptions of inventions, standards, catalogues and so forth — and in forms — a copy of a document, a paper and reference — is quite different for the situational and current information and for every sphere of its use.

The cycles of the information use are different at each stage of the national production. The same information may have a similar qualitative value in time according to to different periods of its use.

For example, a three-weeks (and sometimes a three-month) cycle of the information reporting is quite enough at the stage of R&D. A one-week period of the information reporting could prove excessive for the marketing sphere. In general, as one moves to the sphere of marketing the requirements in the information operativeness are being sharply increased.

Finally, a few words should be said about a very important aspect of information — about its subjectuve aspect. The character of the modern production leads to the wipping off the industry boundaries. A rapid growth of junction directions of science — biochemistry, biophysics, chemical physics, physical chemitsry, agrichemistry, nuclear energy and others — leads to an intrusion of technology and methods of some fields of science and technology into the other fields.*

The interconnection of different fields of production is increasing to a larger extent. Together with the specialization of production operations the concentration of industrial potential is taking place. And one of the main ways is the way of creating large industrial complexes unified by a similar technology or destined for a complex solution of a certain task. Therefore, side by side with the maintaining of the so-called industry structure for a long period of time the functional and technological cooperation will take a more sufficient place.**

It could be foreseen that the advanced development of

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* For example, the achievements in the field of microbiology have led to the creation of the industry of biosynthesis where the technology used is very far from the technology used now in the food processing industry. It is possible to give many similar examples.

** For example, the implementation of electronic and ionic methods of processing, aerosol technology and so forth is taking place in many branches of economy. The construction of large hydroelectric power stations has led to the creation of large industrial complexes with a diversified but energy consuming production; the necessity of a complete utilization of wastes in the timber industry has led to the creation of combined enterprises for complex timber processing with the output of raw woods, construction materials and chemical compounds.

production, on the one hand, would be determined by an enlargement of main production units and, on the other hand, by the creation of large multiindustry and multipurpose industrial complexes with complete utilization of wastes. Even now it is necessary to inculcate the methods of a programmed and purposeful management of economy.

The transition to the programmed and purposeful planning and management requires more complex interindustrial relations not at the production and technological (for example, the transference of new metal cutting methods from one industry to another) but at the causative and program level (for example, in the programmed planning of the development of individual motor transport the designing of new kinds of road cover gives the opportunity of simplifying of a car exploitation and changing the network of service stations).

It follows that the existing methods of the industry differentiation of knowledge and, eccordingly, information should undergo substantial changes. Probably even now it would be necessary to study the question how rational and effective is the principle of an industry approach in differentiating the information.

Thus, the structure of information requirements is rather complex and multidimensional. But the structure of existing information systems predetermines a considerable excess of information and a poor adaptivity (because of a subjective unidimensionality) to the user's needs.* It is characteristic that in the USA the adaptive features of an information system were improved first of all at the account of a rapid development of the nonagency and non-industry consalting business and also at the account of using, between the users and information centers, simulation models which imitate a skilled analytical cervice free of authoritative intrafirm estimations.

5. For the creation of an information system it is very

* Just because of this the main direction of the automatization of an information system should not be the automatization of internal processes of the system (although it is also necessary), but rather the automatization of external connections of the system in order to raise the level of its adaptation to the changing interests of the users.

important to have a clear imagination of the sources of information. What are the sources of scientific and technical information now? Unfortunately, there are a few works on «information» typology of scientific and technical documents,* although just their typology and classification is one of the ways of the rational creation of an information system and information technology.

In Table 1 given below there was made an attempt to determine certain average characteristics of the most important groups of scientific and technical documents from the point of view of their use in the national information system (see Table 1). In addition to the aspects of con-

Table 1

An example of the typology of scientific and technical documents according to information characteristics

Groups of scientifis and technical documents	Average size of a document in pages	Average period storage in years	Use (frequency of request from the fund)
1. Monographs, books	300	10—20	repeatedly
2. Reports in R&D, dissertations	100 220	10 5—7	episodic episodic
3. Periodical and continuous journals, articles	— 5—7	3—5 3—5	repeatedly repeatedly
4. Descriptions of inventions for patents and author's sertificates, descriptions for applications on inventions	5 5	permanent 5—7	repeatedly episodic
5. National standards, industry and repuqlican standards	10 10	5 5	repeatedly repeatedly
6. Catalogues	10	3—5	repeatedly
7. Drawings and designing documentation	1	2—3	repeatedly
8. Administrative and management documentation	1—2	0,5—1,0	single use
9. Planning and economical indices	0,01	0.1—0,5	single use

Footnote: Rough average data are given in this table.

* The attempts to give a typological description of scientific technical documents are made in e. g. Shoukhardin, S. V., «Osnovy istorii techniki», Moscow, USSR Academy of Sciences, 1961; Dobrov, G. M. et al., «Machinnye metody analisa informatsii ob opyte nauchnotechnicheskogo rasvitiya», Moscow, «Nauka», 1972 and so on.

lents mentioned in the table of sources which are determined by the type of a document it is very important to know how many units of storage should be in the fund, what is the average size of document, how often it is requested from the fund, what is its compulsory period of storage.

Evidently, just these characteristics predetermine the selection of the most convenient form of storage and dissimination of above mentioned documents for their use by different users. It is als evident that the bigger the number of the documents in the group and the group and the more frequent is their use the more important is the unification of document parameters for a given type of documents. It should be kept in mind that some information organs take part in the preparation of a document (for example, the information services of Patent agencies, centers for registration and storage of the R&D reports and so on), the other ones are working with the prepared document received from the outside. Therefore, not all the information organs can equally take part in regulaing the information flow.

In addition, the necessity of unification of requirements to the sources of information is becoming shrper from year to year. It is particularly important in connection with the introduction of different microforms of documentary records, their carriers and devices for their reproduction.

The lack of unified standard rows of scientific and technical documentation complicates the information technology to a considerable extent, reduces the operativeness of information, hampers the development of modern technological means. Just using standardized sources of information it is possible to speek of the development of an information technology stipulating the preparation of a source, determination of its importance, distribution to a necessary storag (information retrieval system [IRS]), input into automatic systems of processing and use of corresponding means of microminiaturization.

6. Finally, the selection of principles of dissemination, storage and use of information is very important.

In 1972—1973 CNIIPI conducted a research work on information requirements of enterprises and organizations of many ministries and agencies of the country. The

analysis of the results gained showed that information interests of enterprises and organizations of the economy could not be determined by a complex of certain multitude of elementary interests.*

In general, the user's interest can be defined as a set of intersecting multitudes of requests of different hierarchical level. For example, one user needs the information of the high hierarchical level (all the information concerning the sections of IPC from «A» to «H») the others need all the information relating to the section «H», two classes from the section «B», one subclass from the section «C», one group from the section «E» and one subgroup from the section «D».

On the grounds of a preliminary analysis of the data gained it is possible to make the following conclusion:

— the type of an institution using the information determines the character of information requirements in many respects (for example, an overwhelming number of users needing the whole set of information are universal libraries; the users of information at the level of the IPC sections are the industry information centers and so on);

— a rational scheme of differentiation of information may not be based upon the departmental (industrial) affiliation of the users;

— profile interests of the majority of users are virtually broader than the object—subject field determined by the departmental affiliation.

In the practice of creation of IRS for the patent and information search the problem of the selection of the approach to the definition of the search field is especially acute. The fact is that owing to the penetration of techniques and methods of one technical field into another one vast subject fields were formed which had a multiindustry character not only because of the multiple use of a certain method in different industries (for example, the methods of welding, stamping, cutting etc.), but because of keeping the principle of a functional similarity

* As far as the language of International Patent Classification (IPC) was used in the research, which is notable for a considerable aterminological and semantic power, the correspodence of the request to the IPC heading of the lowest level was understood under the term of the elementary information interest.

(for example, the methods of extraction, filtration, dispersion and extrusion which are used variously in different industries) in diversed conditions.

It is quite natural that in those cases when the field is of an interindustry character the creation of a search system while keeping the principle of functional similarity of all the indexed objects is the most preferable because the experience of one technical field could be transfered to another fiel in the most efficient manner with the use of such an IRS*

Unfortunately, neither existing classifications nor thesauruses of a descriptor type allow yet to build an optimum network of IRS with the minimum intersections of the information fields.

It should be also kept in mind that the systems of regulating the concepts considered concern, in general, the fields of science and technology and virtually do not reflect the concepts that are necessary for the technical and economic appraisal of information and the selection of the spheres of its use. But it is the technical and economic appraisal of information that allows to ensure the input of the information into the national production system through the management link.**

7. What conclusions can be made on the basis of the above mentioned brief listing of problems related to the creation of a large national information system?

First of all, it is necessary to define clearly qualitative characteristics of users according to the main stages of scientific and production activity. Evidently, a new approach to the differentiation of information broadens considearbly the field of a «scientific and technical information» on account of inclusion of new categories of users who need both scientific and technical and conjuncture and economic information. To a certain extent this activity could be realized even now with the help of

* Such an approach is especially important in determining the patentability of a technical solution in the process of patent examination. The IRS, of which the subject field was determined on the basis of a functional similarity, «solves» the search tasks for the forecast and analytical research in a better way.

** Subsequently, in the course of the development of simulation models, the criterion of the necessity of the input of information into the system would probably be not only its engineering and technical but economic importance too.

expanding and consolidating of a subordinate information service which is to be a compulsory connecting link of an internal mechanism of the system (of an enterprise, subject complex etc.) and environment. The forecast changes in the national production should be obligatory taken into account when designing an advanced structure of an information system.

For the realization of an information dissemination scheme according to subjective characters, it is necessary to develop a system for the distribution of information based upon the study of the processes of specialization and concentration of production. Such a system should the basis for the creation of an IRS network which ensures a minimum overlapping of the fields of search. Taking into account that the development of methods of demarcating the fields of search takes much time it is expedient to study the possibilities of inverting the search characters of documents introduced both into IRS built on the basis of the principle of the object functional similarity and into IRS of an object—subject character.

The creation of the IRS network will allow to eliminate the necessity of publicating the reference and bibliographical information altogether. A centralized processing of information will be reduced to the processing of bibliographical descriptions wht the aim of selecting thr directions of distribution and creating the reference material (on the machine readable carriers) necessary for exposing the ties between the documents.* The documents themselves will be operatively input by a responsible information center (by an industry or regional center) into a certain IRS taking into account the peculiarities of its language. As far as the user addresses the information episodically at the certain stages of his activity the use of IRS with the help of remote communication channels will ensure the fast receipt both current and relevant retrospective information.

The methods of unification of information units and machine readable abstracts suitable for the automatic input of information into IRS should be developed in order to insure a fast input of the current information into IRS. Such an abstract should possibly contain: a unified bibli-

* One of the first such systems is the system of revealing the analogous patents realized in CNIIPI.

ographical description, a search character of the document, factographic data, a code of the information appraisal (type of a document, extent of novelty, importance etc.). It is also evident that the full texts of documents should be input into IRS and for that purpose the standard rows should be developed which are close to the characteristics of the documents suitable for storage on the similar microcarriers.*

Principially, the system of issuing the origional documents should be reorganized. In our opinion, the following system is preferable.** It provides for a drastic reduction of the number of journals (only especially important and principally new materials and review materials should be published in them) and an extension of the publication of original articles preprints. Under these circumstances it is expedient to draw together the activity of scientific and technical publishing houses and information agencies.

A considerable amount of work should be accomplished in creating a specialized subsystem of conjuncture and econimic information without which it is impossible to evaluate the csientific and technical information and to provide for the information service of production and marketing.

The scheme of dislocation and functions of the existing information organs should be reconsidered in conformity with the advanced scheme. First of all it is necessary to study the possibilities of a subsequent specialization of the centers. Thus, the All-Union information centers would probably become to a larger extent the centers of the dissemination of machine readable information to the middle information organs (industry and refional organs). Combining the functions of departmental and All-Union centers they should jointly become the basic organs of the world information (in particular, reference) system. It is also evident that the trend of a further specialization

* For example, an 8-frame punchcard with the rate of the original diminution equal to 22 : 1 is convenient for the descriptions of inventions and for drawings and designing documentation. Microfiche is convenient for R&D reports, books, journal articles, catalogues and so on.

** Kolobov I. P., «On the unified state system of scientific publications and scientific information on dömestic original materials». (Preprint).

of national information agencies on specific types of literature would remain in force.

The so-called industry information centers would be transfered into the centers of analysis of information on the basis of a group of allied IRS but the territorial interindustry information centers would become more and more specialized as repositary and reference centers.

Finally, one of the main questions is the problem of the development of «an information technology». Such work of a broad character was accomplished in CNIPI during the period of 1967—1971.*

However, today thereis no detailed developed methodology of using information materials at every stage of national production that hampers «the introduction» of information into all the scientific and production processes. The necessity of the development of such a methodology is especially important for the organization of the information service for complex programs carried out by many ministries and agencies.

When developing the technology of the information service one of the most important factors is the appraisal of the economic effectiveness of the solutions selected. Virtually, such a situation is met almost at every stage of the activity. For example, when considering the results of the domestic R&D selected for development it is necessary to consider an opportunity of buying an analogous licence at the same time. Although such calculations drop out of the limits of a traditional information service they would play an ever increasing role in the future for selecting the information. Therefore, the development of the general methodology of the information service is connected with the development of a great number of prticular methods.

Finally, it is necessary to mention the importance of the work on normalization of scientific and technical documents themselves. It is known that such a work is being conducted within different international organizations. For expamle, a whole set of standards for bibliographical elements of the descriptions of inventions is developed within ICIREPAT, the possibilities of a title-page unification for the descriptions of inventions and the ne-

* A methodology of the information use in forming a technical policy.

thods of indicating certain bibliographical elements are being studied now etc. At the same time it is very important not only to ensure the unification of the form and contents of scientific and technical documents but to develop a unified approach to the evaluation of the importance of sources of information.*. In this aspect, the work, which is being conducted now under the aegis of the World Organization on the Protection of Intellectual Property, on the selection of periodicals that are to be included into the minimum of publications reflecting the modern level of the development of science and technology is of great importance. It is also necessary to solve the whole set of problems related to ensuring the access to publications: to overcome a language barrier, to introduce a unified system of coding scientific and technical documents and so on.

Within the limits of this article it is impossible to to give detailed arguments and calculations concerning the expediency of some assumptions mentioned above. However, it should be emphasized that they are given speculatively, but are based upon the study of an extensive satistical material and the generalizations of ideas of a broad circle of specialists.

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* One of such proposals was made by G. A. Lebedev (see «NTI», 1972, series 1, No. 4, pp. 9—14).

B. Tell, Z. Gluchowicz
(SWEDEN)

A PRAGMATIC APPROACH TO RESEARCH IN INFORMATION AND DOCUMENTATION

Preamble

The following report is an answer to Prof. Mikhailov as follow-up on the unfinished dialogue he and the author carried on at the 12the FID Congress in Budapest in September 1972. The discussion took place in the open meeting of the FID/RI Committee.

It was evident that while Prof. Mikhailov looked upon the user and his reactions to information from the input end, my approach was the opposite, namely to accept what the input migth be and by man-machine methods achieve a selection which, hopefully, will make the user happy.

While Prof. Mikhailov adjusts his input and processing methods to this end, our operations are solely based on thereadjustment of the screening capability of the system and on various ordering methods. In the discussion it was pointed out that by careful analysis of the parameters and variables involved at both the opposite ends—input and output—it might be possible to arrive at a synthesis, namely an optimization of essential elements in the total information transfer chain in order to serve the ultimate user.

The present report is intended to disclose at the output end those parameters and variables we have identified so far to be of interest for the user.

The intention behind this report is not to close the dialogue, but to make a contribution which might open the

dialogue to a broad discussion which can further the research in the I&D field.

For the elaboration of the report the author likes to acknowledge the valuable collaboration of Zofia Gluchowicz.

1. Introduction

The Swedish government has taken an active interest in developing a policy for economic growth. In 1967 it launched a program for the promotion of technological development and industrial growth, in which a plan for the development of scientific and technical information was included. The government was especially interested in studying the viability of mechanized information services in the field of science and technology, and the utility they could offer to users in research and industry. The Royal Institute of Technology library was chosen as the responsible agent for the establishment of a mechanized service for users in science, industry and education.

The requirements for the computer operation of a service had been thoroughly studied during Tell's years as department manager of the Swedish nuclear establishment, AB Atomenergi. Then, in 1967 the Institute library received the first grant of Sw. Cr. 80,000 ($ 16,000) to initiate a computerized service in the field of mechanical engineering. During the years the scope has extended and the grant has increased, and it has now stabilized around 1 Million Sw. Cr. outside the ordinary budget of the library. Half of that sum goes to the salaries for documentalists who have been added to the library staff. Thus, the fundamental requirements for staff and funds have been fulfilled by the new policy.

2. The basic tasks of an information retrieval service

A computerized information system has to perform a number of basic functions, such as

- entering various types of data;
- formatting, abbreviating and coding of data;
- processing information, i. e. seaching, maching, sorting etc.;
- producing standardized or specialized types of output, e. g. bibliographies, indexes, SDI etc.;

— answering specific, one—time requests, i. e. retrospective searches;
— reacting to various errors;
— relating to other information systems.

3. The organization of a new computerized service

In order to start a computerized service the best choice, at least at that time, seemed to be a current awareness service—SDI—Selective Dissemination of Information. SDI is a system developed by late Hans Peter Luhn at IBM in 1959 for alerting participants about new publications such as journal articles, reports, conference papers etc.

The system should be so designed that the selection and announcement of current documents should have a high probability of interest to the individual user. For this purpose the user must submit and routinely modify his «interest profile» which serves as basis for the computer matching of stored profiles against titles of indexing terms in the references.

In order to keep the interest alive on the part of the participants, the SDI service must be prepared to offer a comprehensive coverage of the literature, and a backup of pertinent material. One of the major tasks in the expansion of the library service during the past five years has been to answer the incoming queries, resulting in profiles, as broadly as possible, and install new bibliographic data bases in case they could contribute to the broadening of the subject coverage.

By using a general information retrieval system [1], it has been possible to include additional files in the service, so that the search procedure and output routines can be the same. By a «general» system we mean that it can make use of all the keys, tools and techniques for selecting references in response to a search request, e. g. classification schemes, keywords, words in titles or abstracts, author or author affiliation names, citations etc., all of which can be used in traditional, manual searches.

4. Sources for technical information

SDI — system at the Royal Institute of Technology, Stockholm.Databases. 1972.

1. ISI Science Citation Index Source Data Tape from the Institute for Scientific Information (USA), containing interdiciplinary information from the most frequently cited journals in science and technology, stores about 400 000 references a year.
2. MechEn Mechanical engineering from the Royal Institute of Technology, Stockholm covers the literature in mechanical engineering and metallurgy and stores about 40 000 references a year.
3. CAC Chemical Abstracts Condensates from Chemical Abstarcts Service (USA) stores about 340 000 references a yeart to literature in the field of chemistry.
4. Inspec Information Service in Physics, Electrotechnology and Computers & Control from the Institution of Electrical Engineers (U. K.) in collaboration with the Institute of Electrical and Electronics Engineers (USA). This is the most comprehensive information system within the fields given in the title and it stores about 120 000 references a year.
5. Metadex Metals Abstracts Index Tapes from the American Society for Metals in collaboration with the Institute of Metals (U. K) stores about 24 000 references ayear to literature in the field of metallurgy.
6. GRA Government Reports Announcements from the National Technical Information Service (NTIS), USA. This information system stores about 40 000 references a year to reports on USA federal sponsored research in the fields of science and technology.
7. COMPENDEX Computerized Engineering Index from Engineering Index Inc. (USA) covers the literature in engineering and technology and stores about 72 000 references a year.
8. NSA Nuclear Science Abstracts from the United States Atomic Energy Commission stores about 50 000 references a year. Literature searching on the NSA database is carried out in close collaboration with AB Atomenergi.
9. ABIPC Abstract Bulletin of the Institute of Paper Chemistry from the Institute of Paper Chemistry (USA) stores about 10 000 references a year to

recently published articles, patents, and theses in the field of pulp and paper chemistry and technology.

10. WOOD **WOOD** from **the Swedish Forest Products Research Laboratory** and the **Royal Institute of Technology Library, Stockholm** stores about 15 000 references a year in the field of wood technology.
11. FSTA **Food Science and Technology Abstracts** from the **International Food Information Service** (FRG) covers the literature in food science and chemistry and stores about 12 000 references a year.
12. ERIC **ERIC Master Files** from **the Educational Resources Information Center** (USA) stores about 30 000 references a year to reports and articles, and other publications in pedagogics and modern educational science.
13. NYFLI **Accession List** from **the Royal Institute of Technology Library, Stockholm** annually stores about 7000 titles to literature aquired by the libraries of AB Atomenergi, Chalmer's Institute of Technology, and the Royal Institute of Technology.
14. STAR **Scientific and Technical Aerospace Reports** from **National Aeronautics and Space Administration** (USA) stores about 45 000 references a year to reports from all fields connected with aeronautics and space technology.
15. IAA **International Aerospace Abstracts** from **the American Institute of Aeronautics and Astronautics** (USA) stores about 50 000 references a year to journals, meetings, patents, and other literature in the same field as STAR.

Databases 14 and 15 are searched at the ESRO documentation centre.

5. Implementation of the data bases into abacus & vira

The basic approach employed has been to use a general processing format into which a record of a particular output of different files can be converted by a reformatting program so that its records can be searched. The success of this pragmatic approach to the compatibility problem of various tape formats greatly depends upon the hospitality of the search record format. The ABACUS

was designed in 1966, before the MARC pilot program and the interchange format reflected in International Sandard ISO/DIS 2709 which is foreseen as the standard for UNISIST. However, the ABACUS record has

Table 1

The Reformatting of ERIC Report Resume Master Data Set Fields into the ABACUS Format

ERIC		ABACUS		
Field name	Field identification no. in hexadecimal	Searchable	Printout	Deletion
Sequence	0000			x
Add Date	0001			x
Change Date	0002			x
Accession Number	0010		x	
Clearinghouse Accession Number	0011		x	
*Other Accession No.	0012			x
*Program Area	0014			x
*Publication Date	0017		x	
Title	001A	x	x	
Personal Author	001B	x	x	
*Institution Code	001C			x
*Sponsoring Agency Code	0020			x
Descriptor	0023	x		
Identifier	0024			x
*EDRS Price	0025			x
*Descriptive Note	0026			x
Issue	0028		x	
Abstract	002C			x
[illegible]	[illegible]		x	
*Contract Number	002E			x
*Grant Number	002F			x
*Bureau Number	0030			x
*Availability	0031			x
Journal Citation	0032	x	x	
*Institution Name	0080	x		
Sponsoring Agency Name	0084			x

* Not Used in CIJE

many characterisitcs in common with MARC and ISO. A directory to the whole record maps out the record length, the data elements present, and the number of characters in each element. The directory is a fixed field header followed by variable data fields. The fixed fields give the address to, and the length of the variable fields. The items of interest in the external data base are selected, and fields in the ABACUS format are allocated by the reformatting program. Depending on the amount of information on the external tape, the identification process differs from one format to another.

Among th : more extensive format in the databases are

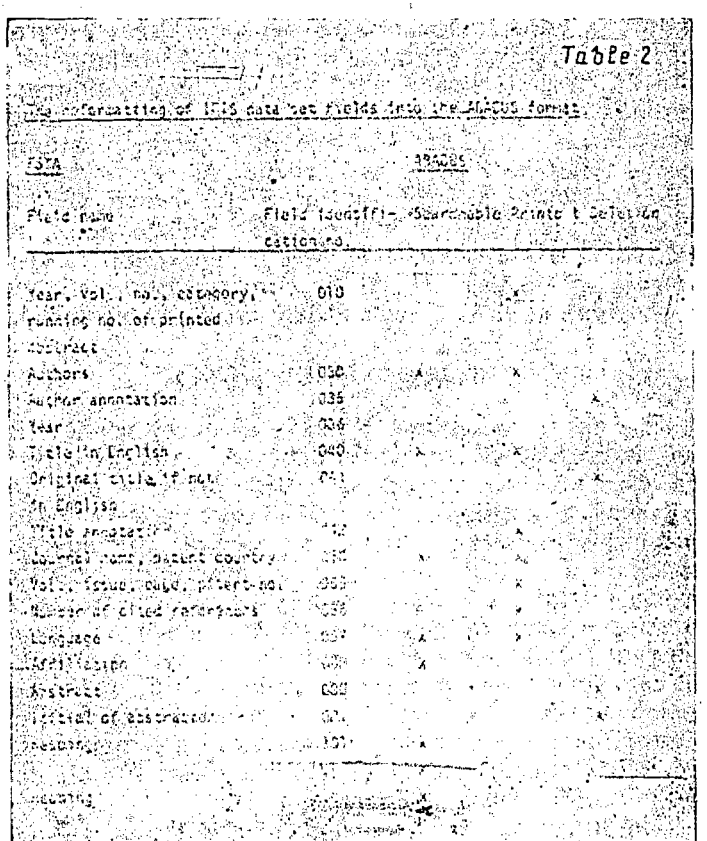


Table 2

Reformatting of ISIS data set fields into the ABACUS format

ISIS		ABACUS		
Field name	Field identification no.	Searchable	Printed	Selection
Year, vol., no., category, running no. of printed abstract	010		x	
Authors	030	x	x	
Author annotation	035			x
Year	036			
Title in English	040	x	x	
Original title if not in English	041			x
Title annotation	042			x
Journal name, patent country	045	x	x	
Vol., issue, date, pater.t-no.	050		x	
Number of cited references	056			x
Language	057	x	x	
Classification	060	x		
Abstract	080			x
Format of abstract	081			x
Keywords	101	x		
Heading				

ERIC Report Resume Master Data Set and Government Reports Announcements many of which fields are not applicable in the shorter format of databases containing references to journal articles. Not all fields in the different databases are of interest to the users. Thus, at present, some fields are deleted when reformatting into the ABACUS. Table 1—2 shows the ERIC Report Resume Master Data Sea Fields and the International Food Information Service—IFIS—and their treatment in the ABACUS record. Even if documentation is provided by a data base producer, the reformatting specification is written after inspection of tape dumps.

In general, the reformatting of the different tape formats is rather straightforward work of 30 hrs programming, even if they deviate from the ISO interchange format into which, it is hoped, they will eventually change. Essentially, the allocation of fields in the ABACUS program depends on the fields identification numbers within the record types for reports and articles. As can be seen from Table 1—2 the 26 fields in the ERIC format yield 5 fields and the 17 fields in the IFIS yields 8 fields in the ABACUS set of searchable fields. The search terms can operate within these, since they are specified with regard to the type of field in which they are to be searched.

6. Profile characteristics

The construction and revision of query profiles is an task in an SDI system which demands an effort both from the user and the subject specialist. When a user wants to submit a question to the SDI system he is requested to formulate his field of interest in natural language, which means in a normal narrative way, describing his interest in some detail. It has proved very useful for the user also to supply some references to papers which he considers relevant to his query. He could also provide a list of significant terms and, if possible, make a draft of the actual search profile. The staff has prepared a Profile Design Manual which explains the principles of a computer-operated information retrieval system and describes all details of the profile construction.

The interaction between the staf and the user is essential for a successful search. On the basis of the user's state-

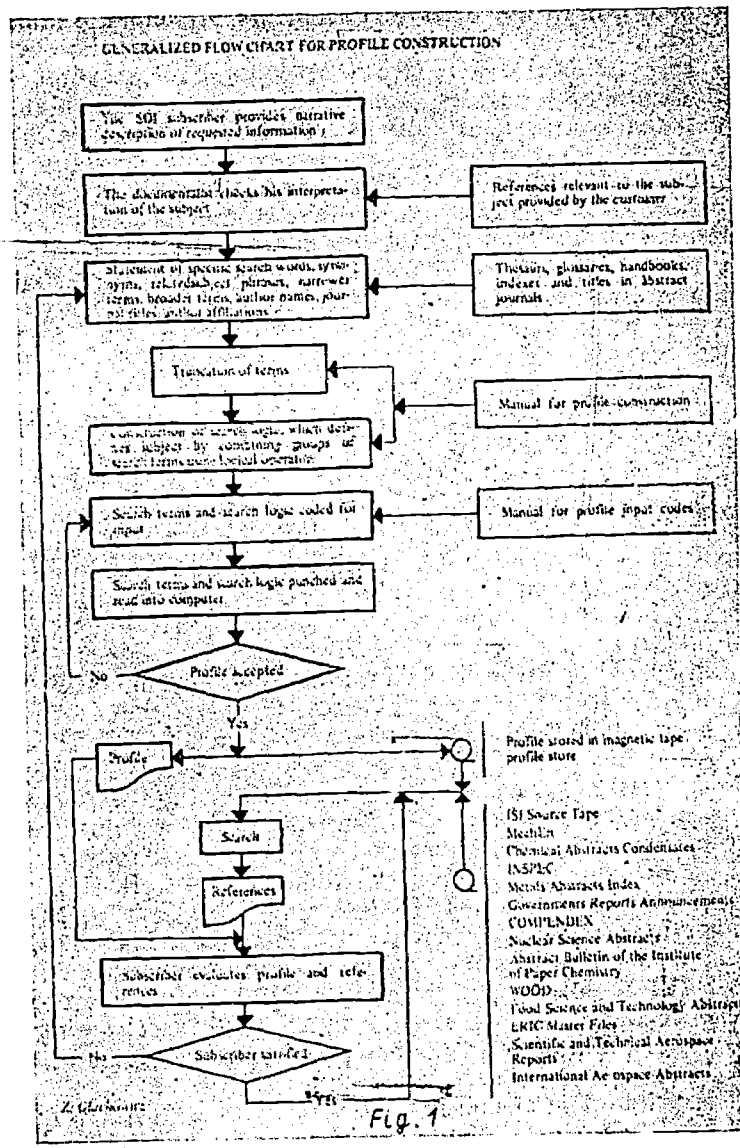


Fig. 1

ments the subject specialist specifies the question by making a list of significant terms, which might occur as po-

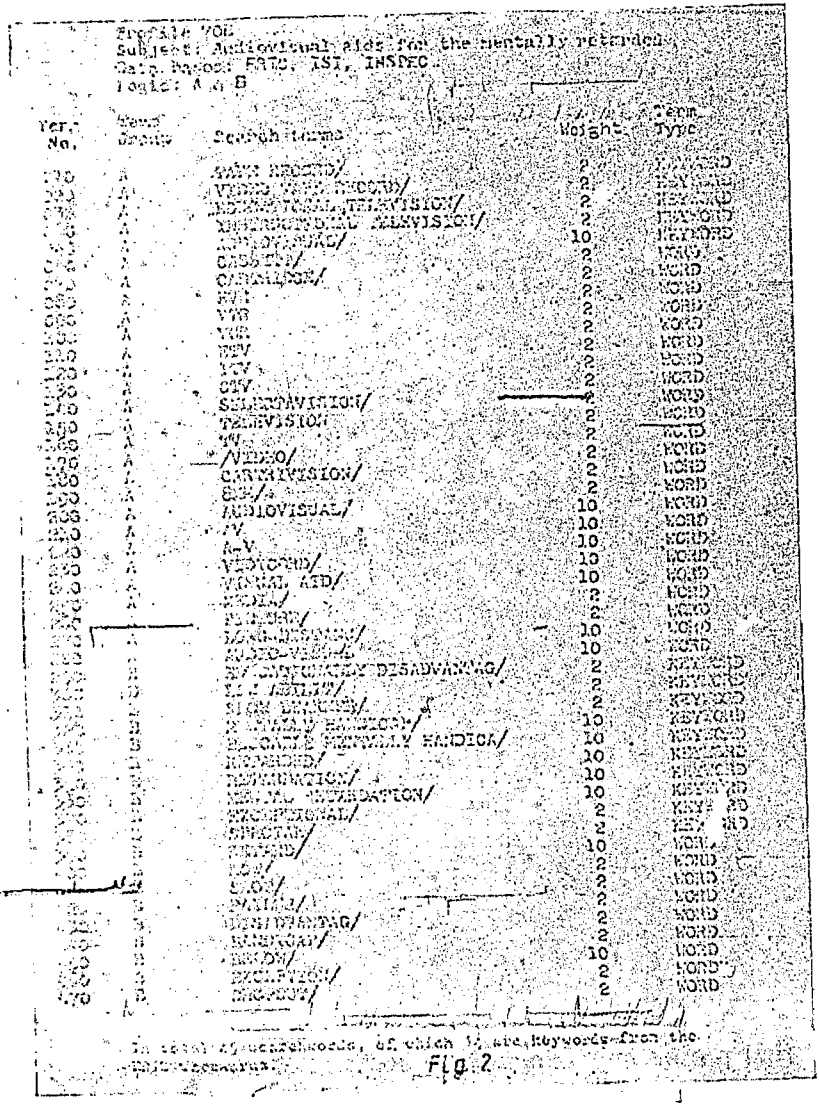
tential words in the titles of documents. Among the staff there are subject specialists in education, psychology, business administration, electrical & mechanical engineering, chemistry, physics, etc. Furthermore, the list might also include authors, affiliations, and journal titles. As the system permits search both on keywords and on natural language used in titles, the subject specialist uses thesauri, handbooks, dictionaries, and all other means he might find helpful and relevant for the formulation of the profile. He has to make a special point of checking the printed volumes of the corresponding databases to find the occurence of terms when used alone or in combination with other terms. A generalized flow chart, Fig. 1, has been constructed by Zofia Gluchowicz [2].

While the keywords must be written exactly as they appear in the Thesaurus and on the tape, the free text terms in potential titles can be truncated both at the beginning and at the end. Truncation facilitates retrieval of items containing word fragments which are common to different forms of a word, and words within words can be searched for. As will be seen from examples below, suffix (right-hand) truncation occurs very often, while prefix (left-hand) truncation is more unusual. Both suffix and prefix truncation is, on the other hand, more common. For example, the truncated term (CASSETT), where the slashes stand for truncations, will retrieve STEREOCASSETTES, VIDEOCASSETTE, CASSETTE—RECORDER, CASSETTE/CARTRIDGE, etc. As can be seen from Fig. 2—3 the terms are numbered sequentially in the profile printout to facilitate updating. The terms are also grouped together, and the groups are indicated by capital letters A, B, C etc. Terms, or groups of terms, are linked together in a logical manner by using «and», «or», and «not» logic. The number of terms in one profile might be upto the system-allowed 150 in ABACUS. In the new VIRA program there are no such restrictions. On the other hand, as charging policy is to count 30 terms as one profile, the average number of terms per profile varies around 24.

The printout of the profile also includes a description in natural language of the query, the search logic, and the list of terms classified according to type of terms such as words, keywords, author names etc. The profile printout and every updating of it is sent to the user. For verifica-

tion a copy of the profile as well as a copy of the search results are kept in the files of the service, transferred every 9 months into microfilm cassettes.

The user's responses to early selections based on the



[illegible]

Subject: Electronic Circuits and Systems

Data base: [illegible]

[illegible]

Term No.	Term Group	Search terms	Weight	Term Type
0008	A	* AUTOMATA THEORY*	2	WORD
0009	A	* COMPUTER SYSTEM*	2	WORD
0010	A	* DIGITAL SYSTEM*	2	WORD
0011	A	* LOGIC SYSTEM*	6	WORD
0012	A	* MACHINE LOGIC*	?	WORD
0013	A	* SEQUENTIAL MACHINE*	6	WORD
0014	A	* SYNCHRONOUS SYSTEM*	2	WORD
0015	B	* NETWORK*	6	WORD
0016	C	* LOGIC*	6	WORD
0017	D	* DIGITAL*	2	WORD
0018	E	* SEQUENTIAL*	2	WORD
0019	F	* ALGORITHM*	2	WORD
0020	F	* AUTOMATA*	2	WORD
0021	F	* COORDINATE*	2	WORD
0022	F	* PARTITION*	2	WORD
0023	G	* FUNCTION*	2	WORD
0024	H	* SIMULAT*	2	WORD
0025	K	* SYNTHESIS*	2	WORD
0026	L	* LANGUAGE*	2	WORD
0027	M	* DESIGN*	?	WORD
0028	N	* MULTIPLE OUTPUT*	2	WORD
0029	N	* MULTI-VALUE*	2	WORD
0030	P	* [illegible]*	2	CLASSIFICATION CODE
0031	P	* [illegible]*	2	CLASSIFICATION CODE
0032	P	* [illegible]*	2	CLASSIFICATION CODE
0033	P	* C02*	?	CLASSIFICATION CODE
0034	P	* C03*	2	CLASSIFICATION CODE
0035	P	* NAND *	2	WORD
0036	R	* NOR *	2	WORD
0037	R	* FLIPFLOP*	2	WORD
0038	R	* FLIP FLOP*	2	WORD
0039	R	* MINIMI*	2	WORD
0040	S	* FILTER*	98	WORD

Fig. 5

first profile approximation to his field of interest are used for improving the profile. Thus, the maintenance of the pro-

file is carried out by adding new terms, and subtracting old ones which do not give satisfactory results, or by opening and tightening the logic. False co-ordinations between search terms from different term groups can also be detected and should be avoided. While constructing the initial profile we try to choose the logical strategy considering the user's wishes, and accordingly decide on the degree of restrictivity for the initial computer run. Often we use a less restrictive logic, i. e. not too many «and» or «not» restrictions, in the initial profile, even if it will result in an output of many irrelevant references, i. e. noise, and then, after a few searches adjust the profile on the basis of the user's avaluation of the output.

7. Processing methods and costs

An inevitable characteristic of large retrieval systems is, that a strategy for searching a small or medium size data base might differ significantly from a search strategy for a large base. During the five years our search methods have passed through the mere masking-off technique, yielding search times proportional to the number of references and terms in the profiles, into a more elaborate technique making use of hashcoding and tree structure searches, thus arriving at an almost logarithmic increase in time when the number of terms in the profile grow. The newest prograf, having the acronym VIRA and written by Rolf Larsson, is run in parallel with ABACUS [3] The present profile. program. PROSA, includes 2,500 statements in COBOL, and the VIRA search program counts 2,000 statements in IBM assembler language.

In order to carry out a rough check of the performance of the profiles on a «management by exception» basis, two statistical tools have been developed. The critical values of the printout to a user are (1) an abundance of references, and (2) no printout. In order to reveal these extremes, every search results in search statistics indicating the number of references for each profile. The form is designed like the scale of the speedometer of many cars, the longer the row of «stars» the more the reason to put ones foot on the brake. Fig. 4 displays part of the search statistics for a run on ERIC. The colums give the number of references to the first digit, the second, etc. Thus, the first profile has

resulted in 6+40=46 references, the second in 8+60+ +300=368 references. On the other hand, profile No 26R has given no output. Furthermore, at the bottom on the form an indication is given of which profiles have received no hits, and those which have received more than 40 hits.

These search statistics give an indication of where the exceptional cases are located among the profiles. The next

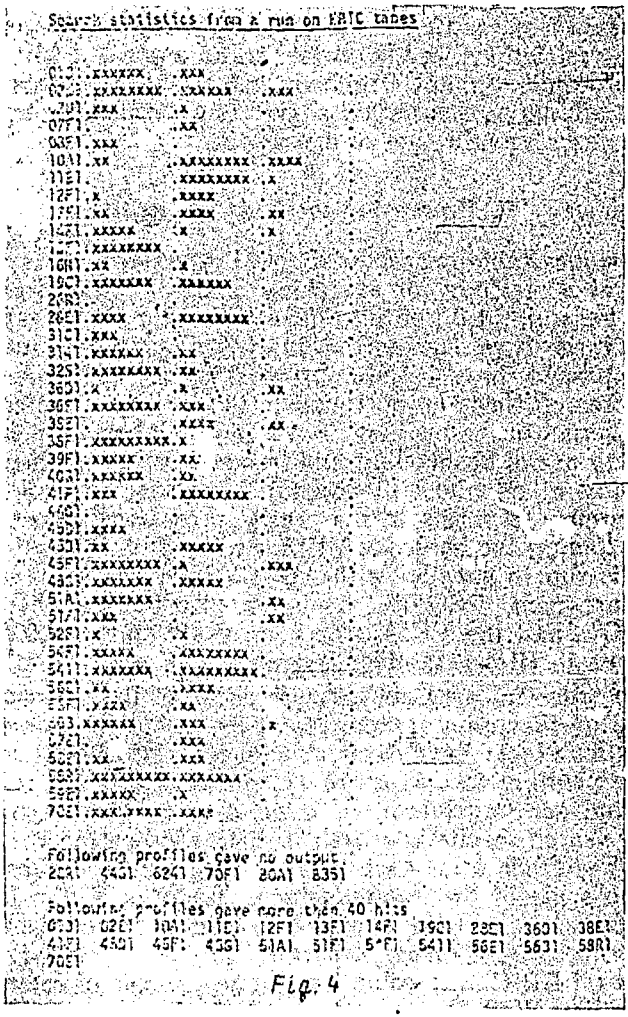


Fig. 4

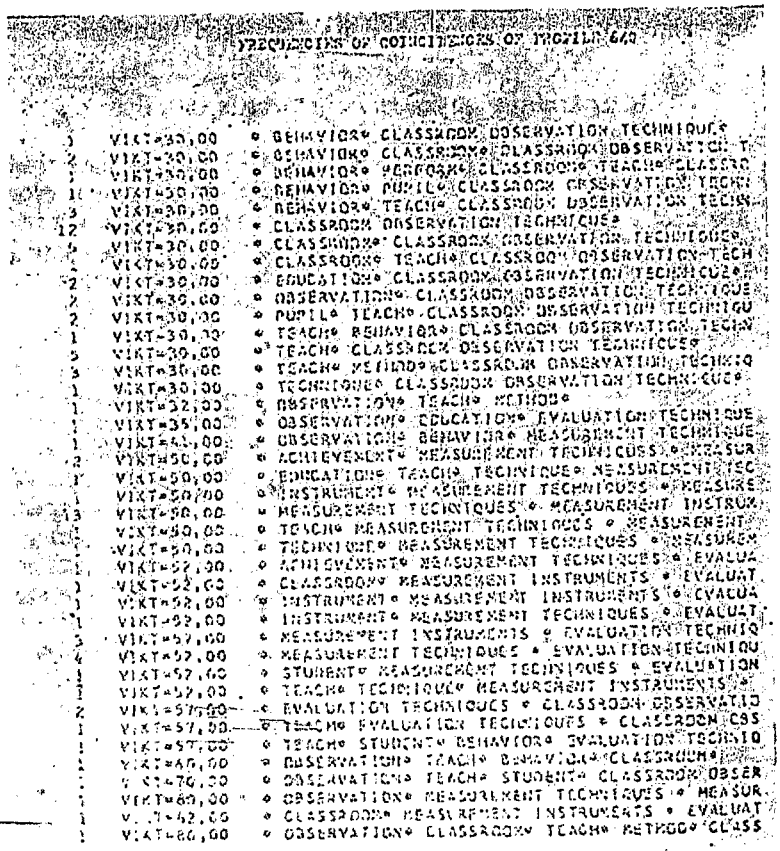


Fig. 5

step is to analyse what causes the no-hits or the great number of hits. In order to find out about the latter case, a listing is also given for every profile stating which terms or term combinations have caused the printout including the frequencies of these terms. See Fig. 5 in which case the first step would be to analyse the combination MEASUREMENT TECHIQUES and MEASUREMENT INSTRUMENTS which occurs 13 times, perhaps in order to change the logic or to place these words in separate groups, if they have given rise to many irrelevant references.

The second column in Fig. 5 indicates the weights we are experimenting with which will be discussed later on.

8. Searching keywords and words in titles

The ABACUS program is designed in such a way that it can process natural language by searching titles and/or abstracts. In the case of another data base, Science Citation Index Source Tapes, the ISI tapes, which covers 2,000 journals there are no keywords or other subject indicators than the titles. Thus, free text search is the only way to open the files. Free text search can be regarded as using a set of skeleton keys to open up any machine readable file. Some files make use of keywords chosen from a corresponding thesaurus of descriptors. Searching these keywords become an additional means for the subject specialist or the user to augment the search performance of the files containing keywords compared with the ISI tapes. When a data base contains keywords, we have recommended that they should be used in combination with words in natural language. In a multi-data base environment the same profile in natural language can easily be used on various data bases, while the use of keywords is restricted to each specific data base which has to be taken into account when formulating the profile. Many of our profiles are searched on several databases since our main principle is to answer the query in its broadest sense disregarding from which data base the responding references will stem.

Especially for questions of inter-disciplinary nature it is obvious that they should be processed on several data bases in order to assure good coverage. It is true, however, that the reformulation of a query into a profile for the SDI system takes place in a kind of dialouge with the computer, focusing on one data base at a time considering both the terminology used in free text, and the metalanguage of keywords or other subject indicators. In order to arrive at a standardization of the query formulation, allowing for different degrees of complexity of natural text and metalanguages, a method has been developed for translation between the various scientific disciplines reflected in the data bases by the generation of vocabularies

and concordance for words in natural language and the various thesauri used.

We have startet work in this area by the compilation of word frequency lists for various data bases as ERIC, CAC, INIS, and ISI.

That the use of the language (the scientific «jargon») is different in varioos disciplines has been displayed when compiling frequency lists for these disciplines. So, for instance, was the first significant word in the INIS system — nuclear energy — REACTOR, and the first in CAC — organic chemistry — ACID, in ERIC — EDUCATIONAL. The non-informative words as FOR and TO occur in almost the same order in these data bases. The following remarks based upon our experience might illuminate the efficiency of descriptors in a thesaurus. The combined search strategy we use, mixing keywords and words in free text, reveals that the present indexing habit in some data bases of using keywords identical to words in the titles is futile. If some of the keywords instead took the place of broad subject categories it would add a new dimension to the search. This is, for instance, the case with the data base INSPEC.

A study should also be made about the proportion of titles that are not useful as content indicators and, thus, not suitable for free text searching. If only a small amount of titles are meaningless, a human indexing using thesaurus keywords should be questionned.

On the other hand, if something needs to be done, especially if we believe that keyword indexing is necessary for the quality of printed indexes or for future on-line retriefal systems of the RECON type, title augmentation of automated keyword assignement seem to be attractive alternatives to expensive human indexing. Such a strategy might cause authors to improve the information content of their titles. This has happened in areas where KWIC indexing technique is used.

Because of the costs of indexing we could never afford it for our own data base in mechanical engineering, wood, paper and pulp industry, covering 250 journals (60,000 references/yr) in three lnguages. Only title augmentation is permitted in case of short titles (less than 60 characters). We know that we can give satisfaction to the users by free text searching only, because at present, we receive

orders for several hundreds photocopies a month as a result of the output.

9. Evaluation and feed—back

At present 1100 users receive SDI service on our databases. After five years of operation on tapes in general we feel that we are still just scratching the surface of computerized information retrieval. We think, for instance, that the printout we now deliver as answers to the queries should go through further refinement before reaching the user. When we consider the construction of a profile as reflecting a specific query, it is difficult to provide a measure of its effectiveness, especially as our practice is to retrieve references from multiple files. Questions about recall and precision lose interest. The essential measure which we can assess is the user's satisfaction which can de expressed on a scale from highly relevant to irrelevant, or by counting the number of documents the orders.

Time and costs of the computer are other factors which can be measured, between computer costs plus the costs for the tapes and the subscription fee for the profiles, leaving other costs, e. q. the construction of the profiles to be defined as common library costs.

The delay time for the same reference appearing in the various services has been studied. We know that ISI is much faster than COMPENDEX or INSPEC, and also than ERIC. However, delay time often does not have a significant effect on the user. It happens instead when he receives an early reference that he judges it as of low interest or irrelevant, while the same reference appearing 3—6 months later is evaluated as very interesting, and he orders a copy. In several cases, it seams as the continuous SDI service has a sort of learning effect on the user.

10. Methods to establish a helpful output ordering

This paper is not intended as a primer on information retrieval but the reader might already have noticed in Fig. 2, 3 and 5 that there are indications of a weighting procedure (VIKT=WEIGHT). We should, therefore, like to mention that we are experimenting with various weighting methods in order to establish a helpful ordering of the output

FILM PRODUCTION WITH THE MENTALLY RETARDED
JUNKALA, JOAN
EDUC TRAINING MENT RETARDED; 4; 2; 75-9
69 APR
VIKT=200,00 * AUDIOVISUAL* MENTALLY HANDICAPPED* RETARD*

A VOCATIONAL PICTURE INTEREST INVENTORY FOR EDUCABLE RETARDED YOUTH
SECKER, RALPH L. FERGUSON, ROY B
EXCEPT CHILDREN; 35; 9; 562-5
69 MAR
VIKT=200,00 * PICTURE* MENTALLY HANDICAPPED* RETARD*

THE USE OF FILMSTRIPS IN TEACHING PERSONAL HYGIENE TO THE MODERATELY RETARDED ADOLESCENT
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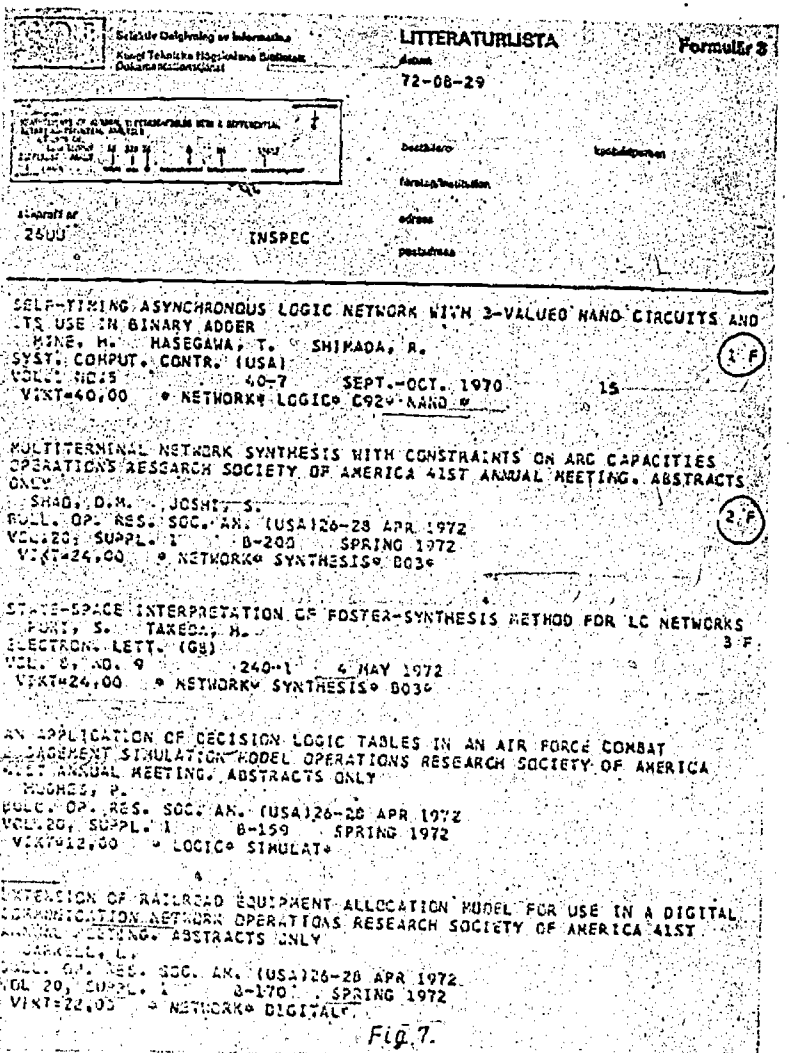
Fig. 6

so that references early on the list should have higher probability of interest to the individual user than the later ones. The method shown in Fig. 2 and 3 is based upon the assumption that the words used in the profile and the words occuring in a reference are related in such a way that the more the words co-occur, the higher the probability that the reference is relevant to the query. This gives us one way of ordering the output. Thus, we note the number of co-occurences and let the search logic operate arithmetically to arrive at the values upon which we base the orders. As can be noted from the profile 70E in Fig. 2, the weight 2 in general is assigned to all terms. However, the user has regarded some terms of greater importance and assigned the weight 10 to them. The three words which pick up the first reference in the printout in Fig. 6 have all the weight of 10, two of which are in the same term group, thus, $10+10$. The logical Boolean operation «and» is translated into multiplication, so the complete expression will be: $10\times(10+10)=200$, as the weight shows. To the four words which pick up the first reference in the printout in Fig. 7 the following weights have been attached in the profile, see Fig. 3, NETWORK—6, LOGIC—6, C 92—2, NAND—2. According to the search strategy of this profile the reference becomes the weight $6\times6+2\times2=40$. In this case it seams to have worked to the user's satisfaction, since he has ordered a copy by circling the reference. Usually we do not influence the user to put in subjectively assigned weights, as we should like to find out more about the objectively assigned weights. This brings us back to the list of word frequencies dealt with under Chap. 7. We could order the references based upon the frequencies of the words in the data base which is our next step in preparation. The underlying reasoning is as follows.

When forming the logical expression in a keyword based system arranged as an inverted file, it is common to base the logical expression upon the number of documents pinned to each keyword. This number indicates the frequency with which this keyword has been used for indexing. Thus, on-line searches on a display terminal usually end by forming the logical expression that gives the minimum output. This means that high frequency terms are looked upon as having less value than those with low frequencies. In a free text search system in the batch pro-



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VOL. 1, NO. 5 40-7 SEPT.-OCT. 1970 15
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MULTITERMINAL NETWORK SYNTHESIS WITH CONSTRAINTS ON ARC CAPACITIES
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FUKUI, S. TAKEDA, H.
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AN APPLICATION OF DECISION LOGIC TABLES IN AN AIR FORCE COMBAT ENGAGEMENT SIMULATION MODEL OPERATIONS RESEARCH SOCIETY OF AMERICA 41ST ANNUAL MEETING. ABSTRACTS ONLY
HUGHES, P.
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DARRELL, L.
BULL. OP. RES. SOC. AM. (USA)26-28 APR 1972
VOL 20, SUPPL. 1 B-170 SPRING 1972
VINT=22,00 * NETWORK* DIGITAL*

Fig. 7.

cessing mode, a search can be based also upon term frequencies using natural language if we build a frequency table from a large sample of references of each data base, say around 30,000 references. The values for ordering could then be established as the sum of the values of the co-occurring terms, if those are expressed as 1/n, where n is the

frequency of the term given by the frequency table [4]. Such frequency tables are under construction for several data bases.

The weighting procedure is only the first step. We are going to study parsing and computational linguistic methods in order to find out the contribution such methods can give to the output ordering. We hope to arrive at shorter lists by introducing a cut-off when the weights are too low, thus saving computer and user time.

11. Personnel and Training

Being responsible for exploring the utility of computerized information services to scientific research, higher education and industry, we have felt that one task has been to carry out research and development of the kind which has been disclosed above. The other tasks are production, management, clerical support, and supporting library service. The overall staff picture for running the SDI service is 12 full-time equivalents. The number of subject specialists are 8, clerical equivalents 4, and programmers 1. In the transitory state we are at present, operating with two systems, ABACUS and VIRA, the profile updating is laborious which has made it difficult, for example, devote time to the construction of group profiles of interest in several areas. SDI is tailor-made for the individual and requires personal attention of the subject specialist, and becomes relative time-consuming, while group profiles are cheaper in updating without the necessity to adapt to individual requirements.

Also the library back-up service has been put under pressure since the introduction of the SDI service. Even if requests for copies of the references put out of some files are shifted over to other libraries where some microfiche collections are located, most references to journal articles and technical reports are handled by our library from its collections or by inter-library loans. In many cases photocopies are ordered from the National Lending Library in Boston Spa, U. K. This follow-up service is found to be important in order to keep the interest of the users.

The effectiveness of the search profile is, to a high degree, dependent on the active interest of the subscriber. The user is more able to influence the effectiveness of his

search profile if he knows the basic principles of the computer-operated information retrieval system and profile construction technique. Therefore we have organized one-, two- and ten-days educational seminars with lectures and exercises in profile construction, see Table 3—5. Research engineers, production engineers and draftsmen of different levels have participated in these seminars. All of them had encountered the increasing need for up-to-date information in their daily work. The participants were not only in-

Table 3

Seminar on the structure and use of scientific and technical literature for scientists, engineers, and technicians

	Programme	
Day 1.	Morning	Introduction to seminar. Tour of the library.
		Structure of scientific and technical literature.
		Guides to primary and secondary information sources.
	Afternoon	The technique of literature search by conventional methodes.
		Practical work: Training in the use of scientific literature. Participants perform literature search on specially chosen items.
		Discussion of seminar.
Day 2.	Morning	Special libraries, information centres, documentation services.
		Computerized information retrieval: The SDI system at the Institute, profile performance and users' feedback.
	Afternoon	Practical work: Participants perform profiles on chosen items.
		Discussion of seminar.

formed about the principles of the SDI system, but were also given an introduction to manual information retrieval methods, see Table 5. This was done because the initial intellectual effort placed on the the user, when he has to define his problem, is the same for both methods of information retrieval.

The user will more easily associate the new technique with the traditional methods and he will be better aware of what the SDI service can offer regarding literature coverage and timeliness. In this way the interest for the SDI service has been intensified and the user take more active part in the handling of the profiles. These seminars are much appreciated and they are given in different parts of Sweden. Lectures on and training in profile construction have also been included in the curriculum for the fourth

Table 4

Seminar on the SDI system at the Royal Institute of Technology (Selective Dissemination of Information)

	Programme	
Day 1.	Morning	Introduction to seminar. SDI from the user co-ordinator's viewpoint. Description of data basis, profile performance, feedback, evaluation, profile adjustment. SDI from the users' viewpoint. SDI users relate their experience of the SDI service.
	Afternoon	Practical work. Training in profile performance on items chosen by the participants.
Day 2.	Morning	SDI from the system designer's and the programmer's viewpoints. Practical work continued as above.
		Conclusions, trends and future prospects for computerized information retrieval. Discussion of seminar.

year for the students of the Institute. The courses have been given by the library staff.

During the two-months course in information and documentation techniques for graduates in science and technology, 60 hours were reserved for lectures and training in computerized documentation and profile construction.

Our experience from trying to market the data bases to scientists and people in industry has been that the most effective means is one-day seminars where afternoon sessions is devoted to group work when every participant under the guidance of one of our staff constructs a profile in his field of interest, see Table 5. We promise then to run it on a trial basis free of charge for a few months. Such a procedure of «taking the service to the user», has appeared successful in attracting potential users.

Table 5

One day seminar on the SDI system at the Royal Institute of Technology (Selective Dissemination of Information)

Programme

Morning	Introduction to seminar.
	Presentation of tapes service and subject categories covered.
	Profile construction for SDI service.
	Evaluation, feedback.
Afternoon	Practical work.
	Participants perform individual search profiles for searching on the different tapes.
	Discussion on seminar.

About 70 engineers and scientists participated in the seminars.

12. The on-line interactive mode

We have now arrived to the stage when, as information centre, we have started to use terminal equipment for on-

line access to computer stored information in big information data banks. The salient component in this man-machine interactive system is the remote console. In our case it is a portable input/output terminal which generates and displays information on a standard television receiver, accepts information from a keyboard and communicates with the computer which recognizes our signals. The information on the television can also be selectively transmitted to a classical teletype terminal at our end, or ordered to come out on the line printer at the data bank centre.

The documentalist as the intermediary between the inquirer and the stored information and/or the inquirer himself can start to negotiate through the terminal with the computer processing the search on the databank. At present we have direct connection with ESRO's (European Space Research Organisation) Computer Center in Darmstadt where about one million references are stored in following files:

Files	Number of references	From year
1. Scientific and Technical Aerospace Reports - STAR	510 000	1962
2. International Aerospace Abstracts - IAA		
3. Computerized Engineering Index - COMPENDEX	105 000	1969
4. Metals Abstracts Index - Metadex	79 000	1969
5. Nuclear Science Abstracts - NSA	190 000	1969
6. Government Reports Announcements - GRA	55 000	1970
7. Electronic Components Databank	4 271	1970
Chemical Abstracts Condensates file is being tested.		
The total yearly updating rating about 280 000 references.		

13. Conclusion

During the five years of activities the documentation centre at the Royal Institute of Technology has established

itself as an information centre in the fields of science and technology.

The SDI service is now well implemented and its activities are used and appreciated by scientists, research workers and engineers at the universities, research institutions and in the industrial communities. Techniques for on-line SDI-query formulation and query alternation adaptive to user feedback are under development.

The on-line connection to the NASA's Recon system in Darmstadt enables us to make retrospective searches in interactive mode. Research is going on for linking up the Swedish network for Library Information system — LIBRIS — with international data banks with the objective to achieve a comprehensive information retrieval system for the whole country.

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H. Arntz

(FRG)

ENCYCLOPACDIC DICTIONARIES FOR SATISFYING USER NEEDS

1. Punctiform and Universal Education

When the talk is of user demands, de usually think of services which exactly meet he user's dominant requirements. For instance, the Information Analysis Centres, which are better called Information Evaluation Centres, represent such services, since they already relieve the user of the selection of the literature and, with the checked condensation they offer him, they match up precisely to te profile of the research work he has in hand, his technical mission, or the duties he has as an official to fulfil. There is no questio: ing the value of these efforts, but they suffice to cover only half of th. mission.

The ideal of earlier centuries was the all-round man of learning, or the universally educated man, who was, in theory, presumed to have a profound knowledge covering all fields. Ever since, at least, the development of the modern sciences and technologies, such a person could no longer exist (if he ever had); we will come back to this point later. His place has been taken by the expert and the man educated in a s, ecial field.

However, this development involves the great danger that not only does our knowledge disintegrate into isolated fragments but also that decisions we are called upon to take are taken with incomplete knowledge. Just as it is a matter of course that only in a single field can anyone possess knowledge that is really profound, so on the other hand is it a matter of course that advantage is taken of all possibilities that exist for the preservation of

a wide general knowledge and, for this purpose, to have at disposal sources enabling the individual time after time to revise, extend and bring up to the latest position the wide knowledge imparted to him at school. No matter how good our school may have been, it is uncontested that within the spheres of rapid scientific, technical, political, economic or social development (and which of those spheres could possibly be excluded?) the knowledge acquired at school is out of date after a decade. We therefore run the risk of being active in our professional life for two or more decades with a general knowledge that is, perhaps, not only outdated but, because it is faulty, leads us into taking faulty decisions and actions.

2. Documentation as Key to the Shaping of the Future

For centuries already, this danger has certainly existed, and equally certainly has it led to many erroneous developments, indeed disasters. Today, the awareness of this is strengthened; it suffices merely to mention «environmental problems», with the concomitant epithets smog, lead poisoning, water contamination and the like.

What has given rise to these environmental problems? The onesided technical evaluation of technical inventions and the subsequent technical decisions based hereon. This holds good for the motor vehicle traffic in te towns and cities as it does for the techniques of food preservation, the disposal of refuse, or the removal of industry's waste gases and waste waters. Nor should it be disputed that the technical information was excellent and the technical feats accomplished on the strength of it remarkable. If, however, today the environmental problems are presenting perspectives the outcome of which can be the extinction of all human life on this earth, the reason is that no consideration was given to the social and biological effects of the technical decisions. Expressed in the technical jargon we use in documentation, this would read: the users' need of technical information was satisfied but there was no social or biological etc. information; nor, in default of education that was growing ever wider, was the need of it realized by those who alone took decisions based upon the technical infromation at their command.

3. Flood of Literature—No Phenomenon of the Present Time

By way of excuse we are prone to fall back upon the flood of literature which, in recent years or decades, has been increasingly obscuring the general view. This excuse is all the more dubious since as far back as 1613 Barnaby Rich was forced to state that the multiplicity of the books that were published was overburdening the world to such a degree that the world was no longer able to take due notice of the superabundance.

Already more than 300 years have gone by since Gottfried Wilhelm Leibniz, oppressed by the volume of what had been published, proposed to Emperor Leopold I an abstracting organ: «There is no concealing the fact that a large quantity of new books are making their appearance at all Frankfurt Book Fairs .... and because of this all sciences are being overwhelmed to such an extent that one no longer knows what one needs in such a quantity and where one is to seek (the information) ...»

And, finally, almost exactly a hundred years ago (1874), and therefore at a time when the current literary output would seem to use today ludicrously small, Lord Raleigh, in commenting on Todhunter's «History of Mathematical Theories», wrote: «Scientific men must often experience a feeling not far removed from alarm, when we contemplate the flood of new knowledge which each year brings with it. New societies spring into existence, with their Proceedings and Transactions, laden with the latest discoveries, and new journals continually appear in response to the growing demand for popular science. Every year, the additions to the common stock of knowledge become more bulky, if not more valuable; and one is impelled to ask, Where is this to end? Most students of science who desire something more than a general knowledge, feel that their powers of acquisition and retention are already severely taxed. It would seem that any considerable addition to the burden of existing information would make it almost intolerable.»

Whatever the argument about the time when the literature explosion first made its appearance, no one will deny that it now exists. Anyone in need of information has to make the greatest efforts to lay hands on it, and,

in his special branch, he will succeed after some time in getting to know the most important sources of information and information centres. Indeed, he may, perhaps, be lucky enough to be supplied by an information centre with information that is eminently appropriate to his special mission, and then we are tempted to say that his user needs are satisfied. ,

However, the more carefully the user profile is outlined, the more exactly it is attuned to the mission in question, all the more will there be the risk that the information is punctiform and blinkered. Only today does what Hugo Krüss said in 1937 apply: «We know more and more». What he wanted to say was that a deeper penetration into partial areas that are becoming tinier and tinier is equivalent to a more and more superficial knowledge of everything that is not precisely relevant to our special mission.

This ought not to be. If, today, we demand that those who have to take decisions have the entire spectrum of the relevant information at their disposal, we are not chasing after any Utopia. We must only realize that apart from the depths into which it is possible to penetrate in a special branch there is also the problem of width and that this is just as important for our profession, our decisions, and the position we occupy in society.

The object of most aids is to delve deeper below the surface. Abstracting organs, manuals, research reports appeal to the specialist and aim at enriching his special knowledge. It would appear to be merely a question of taking a look, in order to satisfy users' needs we have described, at the documentary aids, as if modern society had nothing else to offer. In point of fact, however, modern society has a many-sided instrument that can be utilized for a great number of practical purposes: encylopaedias, encyclopaedic dictionaries, or whatever else they may be called.

4. History of the Enclopaedia

When D. Diderot wrote the famous prospectus to announce, in 1745, the most remarkable of all encyclopaedic dictionaries, the «Encyclopédie ou Dictionnaire raisonné des sciences», he commenced with the memorable words:

«It cannot be denied that, ever since the resuscitation of the arts among us...., that seed of knowledge that imperceptibly prepares intellects for deeper penetration is due to the encyclopaedias.»

Already in those days the encyclopaedias had their history. Man's ardent desire for the fullest information, for a «picture of the universe», for the putting together of the miniature component parts so that an overall mental vision could be obtained must have originated at the moment when the individual noticed that he was no longer in command of the knowledge of his times and that by reading he was no longer to keep integral texts in mind. This may have been the case two thousand years ago with the Greeks, whose flood of literature we pride ourselves on underrating: 700,000 scrolls were destroyed when the library of Alexandria was burnt down in 47 B. C.

The first encyclopaedias still preserved are the 37 volumes of the «Historia Naturalia» of Pliny the Younger, they contained a digest of the works of some 500 authors. With this he provided secondary, or even tertiary, literature as an alternative to primary literature, his intention was, through the quality of his condensations to make the reading of 500 authors superfluous.

The example set by Pliny was followed in Prague by the universal savant Paulerinus (Pavel Zidek, born 1413), who in the 15th century published the «Liber viginti artium», which for those needing informations was a comprehensive exposé of the sciences and arts of the day.

In Germany, the first «encyclopaedia» bearing this name was that published in 1630 in Herborn by Heinrich Alsted in seven volumes. It was followed, in other countries as well, by an uninterrupted chain. For example, in 1768—1771 the first edition of the «Encyclopaedia Britannica» made its appearance, and in 1796—1800 the first edition of «Brockhaus»* was completed.

These particulars are more than a historical recollection. The intention is to provide evidence that for at least two hundred years, and thus throughout the whole of the time in which the development of the exact sciences resulted in the rapidly increasing numbers of publications, there have been encyclopaedia on a considerable scale.

* Encyclopaedia with particular consideration given to present times.

In Germany, H. A. Pierer's dictionary (1822—1836) had 26 volumes and that of J. Meyer (1839—1855) as many as 46. The «Encyclopédie», which appeared from 1751—1780, had 35 volumes.

That being said, are the encyclopaedias fitted for the task we ought to charge them with? Do they open up the general knowledge of the present in question, and do they do so at a level that makes their statements trustworthy? Does Jean le Rond d'Alembert's assertion that an encyclopaedia «is able to replace the library, even for a man of learning, for all departments except his own» still apply?

5. Instrument for Users

Let us quote J. Meyer, who, in 1840, in the preface to «Das grosse Conversationslexikon für die gebildeten Stände» said. «Every encyclopaedia that is available to the masses and intended to meet their needs, and consequently our work as well, must, by its very nature, help to get the better of that oppressive monopoly of knowledge which has for so long been pressing upon the nations; and since, through the communication of all available human knowledge which has a positive value, it provides many thousands with a new means of securing a better fate, of establishing public welfare on broad, sensible and lasting foundations...

«At no time has the tree of knowledge produced branches more numerous and more complete than now.... In recent decades, every one of the sciences has acquired dimensions, just as intrinsic wealth, to such an incredible extent that not even the specialist, although he may have the best memory, is able to keep in mind every important detail and is looking eagerly about him for an aid which can provide him at every sign with the missing tip....

«The educated world of the present bears a different impress from that of the last century... so that education is now determined more according to the extent to which one has imbibed the scientific, artistic, aesthetic and political life of the present... The educated person of our age must be well acquainted with all the principal phenomena of philosophy, theology and literature, with the enormous industrial progress, with the discoveries of natural science and ethnology, with politics, with the great treasures

of history and a hundred other things, or else be able to bring to mind at every moment what is most worth knowing. At no time have the sciences been more intimately connected with practical life; at no time have they been so indispensable to it as now.»

Perhaps the reader will forgive this long quotation. The intention was not to conceal the fact that already, more than 130 years ago, the questions asked were answered: the encyclopaedia that is accessible to everybody, that puts an end to the monopoly of knowledge, that raises general education and thereby increases general prosperity, that improves the social situation. Here becomes clear what influence science had already gained about the middle of the 19th century in all spheres of life; education is, however, measured exclusively by the degree of the knowledge acquired.

This go-ahead view was understood and accepted; otherwise it would be impossible to comprehend the success achieved by the encyclopaedia in the 19th and 20th centuries. It was the aid that kept in readiness, in condensed form, the latest plane of knowledge «in all departments except one's own», and it had to become increasingly so the more comprehensive the knowledge. Research at the University of Michigan has established that about the year 1880 a person in his later professional life had had to acquire about as much more knowledge as he had had imparted to him at school. Ninety years later, this amount of knowledge is something like ten times that imparted at school. If it is not supplied in selected, checked and systematized form, it cannot express itself as education and knowledge but only as confusion and superficial knowledge more dangerous than none at all. In our world of the constantly better primed human and electronic brains, the man who will hold his own the best is not the man with the largest amount of knowledge but the man who disposes over the best selection and arrangement of it.

«An encyclopaedia is a comprehensive work which assembles, organizes systematically and presents in a form easy to survey the total amount of the knowledge its its time, or that of a particular sector», either systematically or alphabetically, it says in the latest Brockhaus.* To as-

* 17th edition, Encyclopaedia in 20 volumes, Vol. 5, 1968, page 591.

semble, to arrange systematically, to present coherently in a form easy to survey, to arrange alphabetically — all these are activities with which the documentalists are acquainted. Perhaps the purchasers of these works represent genuine user interest in the documentary sense to a greater extent than we suspect, which explains the great interest even in the attempt to impart «knowledge by instalments».

6. Knowledge by Instalments

Otherwise the success enjoyed by encyclopaedic journals which, in 200 to 300 volumes appearing weekly (or monthly), result in a complete encyclopaedia of general knowledge, or of a specific sphere of interest, could hardly be explained. This even applies to a few works which, as encyclopaedias de luxe, were too expensive and were therefore difficult to sell but which now, in smaller volumes priced about 2 DM, meet with a rapid sale.

The Italian publishing house of Agostini, the French La Grange-Batelière and the Spanish Salvat are publishing three encyclopaedias in individual numbers. The «Alpha» encyclopaedia is being published in three series, named after the colours red, blue and emerald. In the French edition, the first two have already sold more than half a million copies. The Spanish edition totals 300,000 copies and the English and Italian each 250,000.

The «Alpha» encyclopaedia is arranged alphabetically. In fifteen volumes each consisting of twelve numbers it is to comprise in all 15,000 contributions and an index of 80,000 words. In France, each number costs 2.90 francs and the subscription for the complete edition 720 francs.

«Le Million», whose subjects are concerned with the geography, economy, culture and history of countries, has a total edition of 220,000 to 250,000 copies. The 275 numbers, appearing weekly, will eventually comprise 15 volumes with, in all, about 7,000 pages.

«Les Musées», an encyclopaedia of the fine arts of all countries and ages, for which 260 numbers are planned, has already achieved sales of 500,000 copies.

In an edition totalling 600,000 copies, the French Press Agency «Opera Mundi», in co-operation with the «British Printing Corporation», is publishing the encyclopaedia «Clefs des connaissances». On 28 pages, each number

(price 3 francs) includes articles on medicine, biology, physics, geography, history and art.

These encyclopaedias in weekly numbers are not the typical form of publication. The main purpose of them was to refute the objection that the purchase of an encyclopaedia was not within the reach of every person's means.

7. The Great Encyclopaedias

The attraction of the «great» encyclopaedias has not suffered as a result of the weekly issues. How large the market is reflected by the fact that in the Federal Republic of Germany alone three are being published at present: Meyer's «Encyclopaedic Dictionary» in 25 volumes, the Brockhaus «Encyclopaedia» in 20 volumes and the «Lexikothek», published by Bertelmanns in 50 volumes with 15 additional volumes, each dictionary costing about 2,500 DM.

In the United States, already one family in four, according to statistics for the year 1965, possesses a multivolume encyclopaedia; the position in Europe is, so far, a long way behind this. However, all the indications are that, irrespective of their high price, the dictionaries are easily sold, so that it is obvious that they are being systematically employed to satisfy user needs. The staff for such a dictionary consists of about 50 editors and several hundred authors. Strictly speaking, they produce tertiary literature. It is typical that Meyer's Dictionary, for example, is enriched by hundreds of special contributions signed by the authors; they are state-of-the-arts reports on important fields that are intelligible to the interested layman as well.

However, in this sense, «laymen» are all persons who are interested, including the researchers, technicians or administrative officials outside their specific spheres of activity.

The same idea comes to expression even more strongly in the 15 subject volumes of the Bertelmann Lexikothek. Their subjects — history; countries — nations — continents; literature; art; biology — zoology — botany; man and health; technical science; natural sciences, with, in addition, a world atlas — extend the knowledge provided by the encyclopaedia until it borders on quite expert knowledge,

but always in the sense of d'Alembert's assertion that even for a man of learning the encyclopaedia can serve as a library for all special branches except his own.

The «subject volumes» are an international phenomenon. For example, the Czech encyclopaedia published by the Encyclopaedic Institute in Prague consists of eight volumes of modern subject dictionaries in addition to the twelve-volume general encyclopaedia. They deal with the fundamental themes within the scope of a comprehension of the universe, nature and mankind, of man's material and intellectual culture, and in culture, and in turn add fulness to the information in the main encyclopaedia for users with a more extensive need of information.

The volume of definitions is remarkable: the «Grand Larousse» has 450,000, the «Encyclopaedia Britannica» 370,000, the «great Meyer» 250,000, merely the map section «The World» in the Lexikothek 128,000 index definitions. These figures signify nothing if we compare them with the more than 2.5 million chemical compounds or the 700,000 species of insects. Rather, they signify much if they are set in relation to the need of definition even of the fastidious person as soon as he finds himself outside his special branch. Large dictionaries which for centuries carefully examined all suggestions of how to include «what was lacking» came to the conviction that, as shown by experience, all needs that may arise can be met with 100,000 well-conceived key words.

8. Coping with Information

Let us return to Diderot. For those who wish to obtain comprehensive information, encyclopaedias, he said, will never take the place of books; the are **only** fitted to be consulted.

In the 18th century, the «only» could still be understood as a qualification, since it was possible to command a view of the books that were available for reading in the large amount of time at disposal. Today, the value of the instrument encyclopaedia can certainly not be rated higher than its fitness to be consulted, instead of the large quantities of literature for the reading of which there is simply no time, and therefore to be an information system by means of which it is posible to cope even with an

excessive supply of information in time that is increasingly becoming less.

However, it is possible to cope with the information only if it is understood. Each department of knowledge has developed its own technical and special language, with the great danger that language barriers arise not only between various regions where a language is spoken but also that the linguistic contact is broken between the members of a community speaking one and the same language. At the same time, through their specialization, research reports are becoming increasingly incomprehensible merely from the angle of their subject. This is all the more serious because the people who are charged with the executive work are, for the most part, other than those to whom the research findings become available.

It has therefore become more and more important not only to document, but also to redocument, newly-acquired knowledge, so that it is, for example, comprehensible not only to the technical specialist but also to the non-specialist, not only to the researcher but also to the engineer. This great task, which is often colled «popularizing» and constitutes an indispensalbe link in the satisfaction of users' needs, has been undertaken from time immemoriai by the editors and authors of the encyclopaedias, who, although themselves scientists in the particular branch have, with every sentence, to remember that it is probable that their articles will never be used by technical scientists at all.

9. Instruments not included in the documentation budget

A final argument is not so trivial as it may sound. The large distionaries are in competition with one another. For them, to reflect the latest state of knowledge at the particular time is a real question of existence. They therefore invest large funds; usually it has cost something like 20 million DM before the first sheet of a new dictionary reaches the printing stage. Since the price of the encyclopaedia is in the region of 2,500 DM, at least 100,000 copies have to be sold before there can be a question of any profit at all being made. Even in countries

in which the dictionaries are sponsored by the State, they constitute no burden on the documentation budget.

This is very important. Most suggestions as to how users' needs are to be met result in facilities, services, investments, for which financial funds have to be earmarked. Encyclopaedias are something that must be based soundly economically. Nor can it be said that even in the Western countries they were subsidized by the State because most libraries are public institutions. Even though libraries purchase the encyclopaedias so that they can hold in readiness the information contained in them, they constitute only a fraction of the total purchasers in view of the fact that editions average about 150,000 copies.

It can be said, therefore, that in no country do the encyclopaedias divert money that the State could invest in documentation services for the instruction of users, but that they are freely at disposal as an additional aid.

10. Documentation for a Better Future

Documentation can be a very personal matter; it can help in improving professional training or in providing better information about one's own spheres of interest. Documentation is, however, increasingly acquiring other dimensions; it is being used for the concentrated application of man's overall knowledge for the benefit of economic, and particularly social, progress. Progress is always, however, something that points towards the future; and therefore documentation (or scientific information, or informatics in the East European sense — whatever one likes to call it) acquires heuristic components. Since frequently the emphasis lies not on the decisions to be taken but on their results, it is incumbent on documentation to exhaust all available possibilities for gauging the technical and social consequences.

This has given rise to the conception that bestows clarity upon the expression «documentation policy», which, just as economic policy, with which it is closely associated, must endeavour to achieve that universal knowledge is wholly and properly utilized so as to direct the social development along the best possible lines.

This mission can succeed only if the experts who are responsible for this policy are able to rely on the millions of users they are called upon to serve. The more comprehensive the information to the users, the more fully they find their interests met by documentation, the sooner will they be prepared to make use of the available expedients, to seek advice when faced by any decision, to become documentation-minded.

This in its turn will result not only in more information or data being disseminated and becoming known but in the factual gain being greater than the ethical. No matter how much style and present circumstances may have changed, one will even today be stirred by what Diderot confessed to his reader in the «Avertissement des éditeurs des supplemens» (1765):

«The extraordinary thing about science is that it shows people the way to efficiency, to happiness. To increase the amount of their knowledge means helping them all the better to open out new sources of pleasure... May it be granted to our work, by diffusing the light of science in our brains to extend the realm of the good over our hearts.»

Never has the belief been stronger that, as a result of the importance and presentation of the information contained in it, an encyclopaedia can change men for the better. It would be no impairment of the objectivity characterizing our times if we demand of the encyclopaedias that have so much to offer the users of the information that they be conscious of the refining influence that the imparting of knowledge and perceptions can, properly presented, still, even today, exercise on all who share in such information.

D. E. Shekhurin

(USSR)

SCIENTIST'S CREATIVE POTENTIAL. CLUE TO HIS INFORMATION NEEDS

Connection between the information needs and the creative potential of a scientist. As mentioned elsewhere [1], a selective approach to information support of problem areas having unequal social weights is a major way of improving information service efficiency. This principle means giving priorities to information supplies in the key domains of the national economy and paying prime attention to the most important projects and trends to be pursued in the context of a research laboratory, D&D bureau, or a factory.

Natural implications also follow hence for the creative «laboratory» of the individual scientist, suggesting that selective attitude should be taken to scientists being served depending on their individual creative potential. The fact is that the information needs of a scientist are determined not only by the objective conditions of his work (the problems under study, professional functions, etc.) but on the subjective features — his creativity characteristics (faculties, erudition, personality, ambitions, efficiency, etc., — characteritics that constitute the notion of «creative potential») and the motivations of his creative work (willfulness for contributing to the progress of science, benefiting community, matters of personal prestige and wealth, etc.).

The creative potential is a major stimulus and premise of a scientist's creativity and it exerts a decisive influence on his information needs. For instance, a scientist's erudition, which characterizes his «preparedness» for solving this or that creative problem largely determines the amount and content of information he needs and explains

the particular relationship obtaining between relevant and pertinent information in that case.

The main point is: of all the creative workers of equal qualifications receiving the same information service the **highest «return»** (productivity) **is obtained from scientists having a higher creative potential.**

An argument in favour of giving priority information services to the more gifted scientists is implied in the words of Norbert Wiener: It is probable that 95 per cent of original scientific works are due to less than 5 per cent of professional scientists, but a majority of these works would never have been written if the remaining 95% of scientists had not had contributed to creating the high enough general scientific level [2]. Moreover, as the organizing aspects in science are gaining importance and the managerial functions, scientific foresight and interaction of sciences are becoming ever more essential, the role of leading scientists has been continually growing.

There can be no doubt that the scientific achievements of the leading scientists are dependent on the efforts of the research team in which they work. Therefore, **first-priority informing of the leading scientist should be effected not at the expense of the service given to scientists occupying medium and auxiliary positions but by creating a most favourable environment for the more gifted scientists** that will ensure the full implementation of their creative capabilties.

First and foremost, this presupposes the ability to assess the potential of a scientist, to distinguish a creative person from a noncreative one so as to find the efficient and justified ways and modes of their selective servicing.

Some evaluations of the creative potential and creativity motivations. The difficulty with appraising the creative potential of an individual scientist lies with the fact that the latter's «features» are always unique and singular. So far no clear method for assessing the creative potential of a person exists, in spite of the numerous studies conducied since long to that end. A hindrance in this way was the general bias of scientific creativity researchers towards anaiysing the individual psychic fetures of the eminent scientists and their peculiar mental qualities while underestimating the impact of the particu-

lar socio-historical environment in which those scientists' creative potential was realized. «Interest in inspiration, the mechanism of intuition, subconscious cognitive processes giving rise to the upflares of genius was prevailing» [3].

At present, orientations of many Soviet explorers of scientific creativity have largely changed, primarily towards more concern for the study of the environment in which a discovery was made or the talent of a scientist came to the full development. Even in this case, however, the **role of the informational environment in a scientist's creativity** is as often as not disregarded despite that it is certainly indispensable for a realistic appraisal of the conditions leading to major advances in science.

That this is wrong is particularly evident in view of the close relationship existing between creativity and informational activeness*. The cause of this relationship is the socially determined nature of the processes, ends and objects of scientific creativity, the fact that a scientific discovery happens as a result of experience previously accumulated. A natural corollary of this is the existence of an intrinsic connection between the creative activity of a person and his informedness in the field concerned, the need for knowing all created earlier.

Analyses of creativity of various categories of scientists show that the creative activeness and informational activeness of a scientist are directly connected. A growth of creativity, associated with more intensive search for new knowledge is usually accompanied by a growth of informational activity and a growth of information needs. In turn, the growing informational activeness of a scientist is usually associated with an intensification of creative (independent) research, as vividly illustrated by the dissertation-preparing period.

This direct dependence between creative and informational activities is not limitless. On passing a certain optimum point, the direct dependence becomes an inverse one. This is also graphically illustrated by the period of writing a dissertation. Many failures to keep within the

* Informational activeness characterizes the degree of a scientist's participation in information processes. Its basic measure is the ratio of factual informedness value to the value of objective information needs.

time term granted and to defend one's dissertation are explained by the incapability of the authors for keeping themselves at a correct level of informedness.

It is of a tremendous practical importance to determine the relationship between creative and informational activeness, for by promoting the latter the information agencies can promote fuller utilization of results and enhance an individual's creativity.

Hence it follows that the **informational activeness is normally a characteristic of the creative potential and a form of its manifestation.**

The raising of the informational activeness is thus a key to promoting creativity, enhancing a scientist's creative potential. The analysis of informational activeness can be used as a major method for ascertaining one's creative potential.*

In studying creative motivations and the faciors of differing creativities of scientists with a view to developing standard tests and procedures for identifying persons of a high creative potential, many authors have come to different conclusions. Some believe that differences of creativity spring mainly from motivations rather than from intellectual faculties, the dominant, initative-full, strongwilled persons being those more creative ones [3].

Other authors name industriousness socio-political maturity and the related purposiveness (as a quality of mind, gift, faculties), and inquisitiveness (manifesting the developed and oriented interest in objects and phenomena) as the determinant qualities.

Curious data on creative motivations have been obtained by A. Zvorykin in a questionnaire survey of some 1,000 scientists. About a half of the respondents named an inherent «organic» drive for creation and excitement as the principal motivations. Moral motivations (desire to contribute to social progress and to help people) were named by 39 per cent of the respondents, while 13 per cent referred to considerations of prestige, and 7.4 per cent to those of material remuneration.

Nevertheless, neither informational activeness, nor need for creative work, nor any other personal quality,

* In this case we do not deal with abnormal deviations from the reasonable proportion of the two values, which will be discussed below.

motivation or indicator of scientific productivity taken as such give sufficient grounds for judging about a person's creative potential.

Creativity, or scientific productivity of a scientist is characterized by a set of qualities. Each individual indicator as such can be viewed as just one premise to creative activity.

Besides, depending on the pattern of intellect, character and ambient conditions, the different characteristics may contribute differently to the overall evaluation of the personality. A case in point is the characteristic of erudition — a quality immediately associated with informedness and informational activeness of a scientist.

On the whole, erudition is indispensable for creative success. But, the classification of scientists by type of intellect and character into the phanatic, the pioneer, the diagnostician, the technician, the aesthete, and the methodologist also includes, as an independent category, the erudite. This type of scientist is depicted as a person well informed in his field, posessing an enormous memory and fond of classifications and details. He is no creative nature, however. He does not seek new solutions, and readily adapts his thought patterns to those of others.

Erudites are different, however. Some of them have been playing ever more important roles in the development of science, even though they do not seek for new solutions — this is due to the continual growth of the amount of information. The evaluation and selection of most important information — on the basis of one's own knowledge (especially in case of a scientist capable of generalizing fragmentary data) makes this category of person invaluable for present-day information practice, for finding a short cut to the overall success of the R&D team. ««This exquisite amateurism is the supreme type of erudition verging on creativity» [4]. A reserve contingent for this category is elderly scientists, having a low productivity by the current standard but by no means an «uncreative nature».

On the other hand, the immoderate «hoarding» of knowledge may absorb all creative powers of a scientist in the prime of life, shackle his creative thinking and emaciate his purposive endeavour. The resulting type of

passive erudite, «collector» of knowledge, is widespread nowadays.

These are persons of a weak creative potential who strive to use their good memory to recompense for their shortcomings by sponging up all information that comes their way. Erudition becomes an end in itself and their role is reduced to that of an active spectator.

Finally, certain scientists use their erudition to disguise their creative impotence and mislead others into the belief that they have a great creative potential.

This type, fortunately is not too numerous. This fact is an upshot of the mass invasion of science by individuals actually unfit for it.

Evaluating a scientist's store of knowledge (erudition, informedness and informational activeness) we must thus take account of whether it is paralleled by an adequate scientific productivity, making adjustments for the type of intellect, creative orientation and the professional R&D functions of a scientist.

Other personal characteristics and creativity conditions affecting the activeness and productivity of a scientist can be evaluated in a similar fashion-each has its measure, informedness and informational activeness included.

The above discussion of erudition, which is a major quality of a scientist, suggests that his creative powers depend not just on a set of his characteristics and qualities but **on the proportions of these characteristics within his personality framework.**

Informational environment is a key aspect of the outer conditions stimulating and «nourishing» the creative process. On the one hand, information is the chief goal of a scientists's communication with the external world, and, on the other, it serves for his connection with this world.*

In this case the informational activeness» in important, moreover, as **a possible gauge of a scientist's creative potential**, being connected as it is with his overall

* By giving this priority importance to the informational environment we do not mean to depreciate many other conditions (adequate material and technical supplies, efficient organization of teamwork and the creative process, etc.) as decisive for the final success of a scientist's creative activity.

creative activity. Though exceptions are numerous, as mentioned in conjunction with erudition, and besides, one must know various personality features to be able to create a favouralbe informational environment conductive to the realization of the individual's creative potential.

Modes of appraisal of the creative potential. While there are many practical modes and procedures for evaluating informational activeness, this is not true of appraisal of a person's creative potential.

Capability tests are the common practice abroad. Test methods can be, nevertheless, of use in selecting would-be scientists after these methods will have received due development.

More wide-spread at present are methods based on evaluation of the creative potential and forecasting the productivity of scientists proceeding from the existing results of their scientific creativity. These are the traditional indicators of creative productivity of a scientist (number of progress reports, papers, patents, conference papers, participation in meetings, academic councils, educational guidance). This approach, too, has its pitfalls.

In discussing the quantitative characteristics of creativity, D. M. Gvishiani, S. R. Mikulinsky and M. G. Yaroshevsky write that «... creativity is a domain that it has been impossible thus far to grasp by number and measure, for a scientist's labour productivity (number of publications, patents, R&D projects completed, etc.) is far from being a sound characteristic of his real creative contribution to the solving of urgent problems or of the real productivity of a scientist or a research team. The two often not only diverge but sometimes have no positive correlation» [3].

Indeed, by taking a purely quantitative estimate of a scientist's products one can easily be mistaken as to his real creative powers and the actual contribution to science. The three authors are quite right in this, particularly, in application to the basic research conducted at the institutes of the Academy and in problem-oriented research laboratories of higher educational institutions.

On the other hand, it would be wrong to underestimate the importance of the quantitative aspect in the characterization of a scientist's creativity. The amount of «products», in one way or another acknowledged by the

community (publication being one of these ways), has always been and still is an indicator of the creative exertion, of the concentration of man's spiritual forces on the objects of creativity, a **sine qua non** of big success. It is true, the quantitative indicators must be considered in combination with other evaluations of creativity.

In the USSR specialized R&D and D&D organizations (in which the majority of scientists work) are particularly favourable environments from this standpoint.

Information workers can make use not only of exhaustive data on the quantitative evaluations of the creativity of each specialist in this context, but also to supplement these data with quite a range of qualitative characteristics. This despite the fact that the team-work organization in this case disguises the role of the individual and obviates the detection of the high-potential creators within a team.

Studies in evaluating the level of planned and completed projects have been gaining in scope of late. These data afford more or less objective judgement on authors' faculty for original thinking, efficient use of others' experience, and implementing ideas.

Data on practical use of results seem to be a major indicator of R&D and D&D unit productivity. Combined with estimates of originality, scientific and technological level, economic efficiency, competitiveness, the data on the practical utilization of scientific results present a most graphic reflection of the authors' creative capabilities.

It is sometimes rather difficult to identify the leading specialists within a research team that has achived success by joint creative interaction of everyone and everybody. In informational terms, a team of that sort can be set equal to an individual scientist having a high creative potential.

Indirect assessments are also possible. These include social value of the creative function in question, importance of decisions taken, and service promotion which is usually an indicator of a specialist's faculties.

Another purely formal characteristic for singling out scientists and engineers of a high potential is an academic degree and upgrading of scientific qualification.

Certainly, this is no decisive factor of creative po-

tential. It often happens that the awardment of a degree comes to crown a long and active life of creativity. This should not be exaggerated, however. The degree-holders are generally the people of the highest scientific productivity and also the most active information users [5].

Interesting information can be obtained by analysis of «certification forms» filled in by specialists prior to the procedure, especially their answers to the questions of their biography, methods by which and organizations where they refresh their professional knowledge, proposals for improvements in the field of their occupation, obstacles hampering the further progress, etc.

This allround apparaisal of personal characteristics can provide the necessary reference points for identifying, within the mass of scientists, those marked by a high creative potential and for determining the effective modes and means of their information support.

From the aforesaid, we think, some conclusions can be made:

— The creative potential of a scientists exerts a tangible influence on the character and scope of his information needs. Combined with analysis of the scientific and informational environment, which plays a decisive role in identifying the information needs, the data on the creative potential secure a greater objectiveness in this function. These data make it possible to reduce the effect of a subjective assessment by a scientist of his role and of his creative capacities.

A way to enhance the efficiency of information work is to provide first-priority information service to specialists having a high creative potential.

The high efficiency of this information service system is warranted by the fact that leading scientists take part in decision making processes that have very important social implications. Besides, and this is the main point, this system promotes the full development and employment of the creative capabilities.

The creative potential estimates should be taken into account in assessing the information needs not only of renowned but of budding scientists. This will permit the information officer to exert an active influence on the stimulation and promotion of creativity in young scientists

thus using information as a major means for enhancing creativity.

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Z. M. Mulchenko,
Yu. V. Granovsky, A. B. Strakhov
(USSR)

ON SCIENTOMETRICAL CHARACTERISTICS OF INFORMATION ACTIVITIES OF LEADING SCIENTISTS

1. Introduction

This paper is concerned with a comparative analysis of the information activity of scientists in the domain of chemistry and in a field of physics (low-temperature physics). Assuming that chemical scientists largely tend to obtain new information by investigating an ever greater number of objects pertaining to a given line of research (synthesis of new compounds, study of their properties and reaction mechanisms), while physicists mostly try to find and explore new effects, it was to be expected that information activities in these two domains of knowledge must have essentially different patterns.

In chemistry, the information activity of ten leading scientists was studied (five Soviet and five foreign).

The sources of information on Soviet authors were mostly papers on bibliographies of Soviet scientists (the «Chemistry» series), and the author index of «Chemical Abtracts». The latter was the unique source of information on foreign authors. Citation rates were evaluated for 1965, 1966 and the first two quarters of 1967 on the basis of the «Science Citation Index» (SCI).

In order to provide reference points in time, the information activities of two 19th century chemists were studied — Mendeleyev, D. I. (1834—1907)$_6$ and Butlerov, A. M. (1828—1886), and of another two of the first half of the 20th century — Kablukov, I. A. (1857—1942) and Zelinsky, N. D. (1861—1953).

In the field of the low-temperature physics, the information activities of a group of the leading scientists of the Institute of Physical Problems of the USSR Academy of Sciences were investigated.

Other sources of information used were SCI and a bibliography of published works by the authors studied.* Citation rates of physical authors were evaluated for 1965, 1966 and first two quarters of 1967. (The statistical characteristics and histograms presented below are based on annual averaged values).

The citation rates of the physical authors studied were investigated not only for the members of the sample group, but for all of their co-authors whose names stood first in the corresponding citations. The first-author search error in this case was equal to 13 or 15 per cent. Citations of monographs and papers were counted separately, self-citation was not excluded.

In the subsequent discussion the names of contemporary authors are substituted with codes, for this paper is concerned not with individual features of productivity of the particular authors, but with the specifics of information activities in the two fields of knowledge as represented by the two sample groups studied.

2. Information activity of chemical authors

Table 1 gives the characteristics of information activity of chemists.

The following results are noteworthy.

1. The total number of publications is rather great and on the whole equal both for Russian and foreign authors; moreover, it remains unexpectedly stable from the second half of the 19th and the beginning of the 20th century until our day, varying within the range of 106 to 755. As to the average annual number of publications, it varies from 3 to 19.

One Soviet author, code No. 4, is a striking exeption, marked by an average monthly productivity of somewhat higher than 1.5 publications.

2. By the number of personalized co-authors the differences are very great for the different periods. This

* A list of papers published was kindly placed at our disposal by the Library of the Institue of Physical Problems.

number is very low for A. M. Butlerov and D. I. Mendeleyev, the 19th century chemists. It is much higher for I. A. Kablukov, and quite large for contemporary authors and N. D. Zelinsky, varying in this case between 41 and 206. Again, no significant difference is observed between Soviet (Russian) and foreign authors. The number of nonpersonalized co-authors (those counted by the total number of joint publications) of contemporary Soviet authors ranged from 100 to 344 (in one case it was 1,305). A similar situation is observed with foreign authors, the number of co-authors ranging from 107 to 472. While for Mendeleyev and Butlerov the number of co-authors per publication did not exceed 0.1, for Kablukov 0.2, and for Zelinsky 0.8, this number varied for contemporary scientists between 0.5 and 2.0. This suggests that since the time of Mendeleyev and Butlerov, the number of co-authors grew more than ten times over. It should be noted that for a majority of authors the total number of publications doubled in a shorter time than this happened for the chemical science in general. While in the group under study the average doubling time of the number of publications is 6 years, the doubling computed for the entire file of data abstracted in «Chemical Abstracts» was 12 years [1]. It is also noteworthy that the time of doubling of the number of co-authors for contemporary scientists (apart form rare expections) is shorter than that of the doubling of the publications number.

Table 2 presents data characterizing the information activity of their maximum productivity*. It follows from this table that:

1. In the maximum activity years the number of publications issued by a scientist within a year may be as high as a few dozens; and in one instance it was 55, that is 4.5 in a month.

2. The maximum activity age of the sample group was found to be very high, sometimes 70, and in one case (Zelinsky) the maximum activity age (as measured by the number of coauthors) was 80. The sloping maximum of age activity of D. I. Mendeleyev is noteworthy — it embraces a period of 22 years.

These findings are at variance with those of H. Leh-

* For Soviet (Russian) authors the age of the scientist in that year is given.

man [2] suggesting the peak of natural scientists' creativity to fall between 35 and 40 years.* It should be noted that one of the characteristics does not show any essential variation in time and in passing over from Russian to foreign authors.

Fig. 1 presents the graph of co-authors of A. M. Butlerov. Co-authorship is denoted by a line whose length is determined by the year of appearance of the last joint publication. The dots on the line indicate the appearance of joint publications. The graph illustrates the emergence and growth of new scientific contacts and their duration. It shows that prolonged and fruitful collaboration of Butlerov with N. N. Zinin, his creative contacts with A. Vishnegradsky, V. Goryainov, F. Ovsyannikov, and B. Rizza.

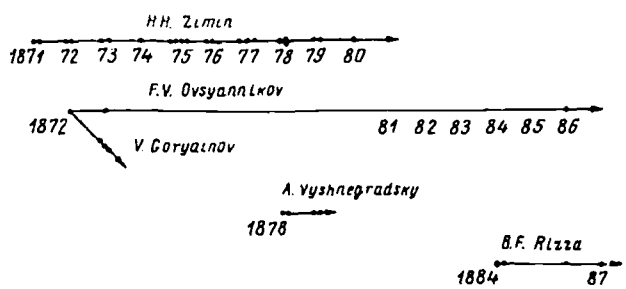

Fig. 1

Graph of co-authors of A. M. Butlerov

Figs 2 and 3 show fragments of co-authorship graphs for two contemporary Soviet scientists. Interestingly, the first creative years of contemporary chemists are characterized by a pattern similar to that of Butlerov — rather slow formation of new contacts, their long survival and high productivity. But after this first period, co-authorship grows in an explosive fashion — numerous ties quickly arise and die out. As the prestige of a senior author

* According to recent data of Pelz and Anfrews [3], two creativity peaks may be imputed to a scientist: one falling between the ages of 35 and 40 and concerning the «depth» studies, and the other at the age of 50 to 55 and pertaining to «extensive» studies exploring ever new objects by methods developed earlier.

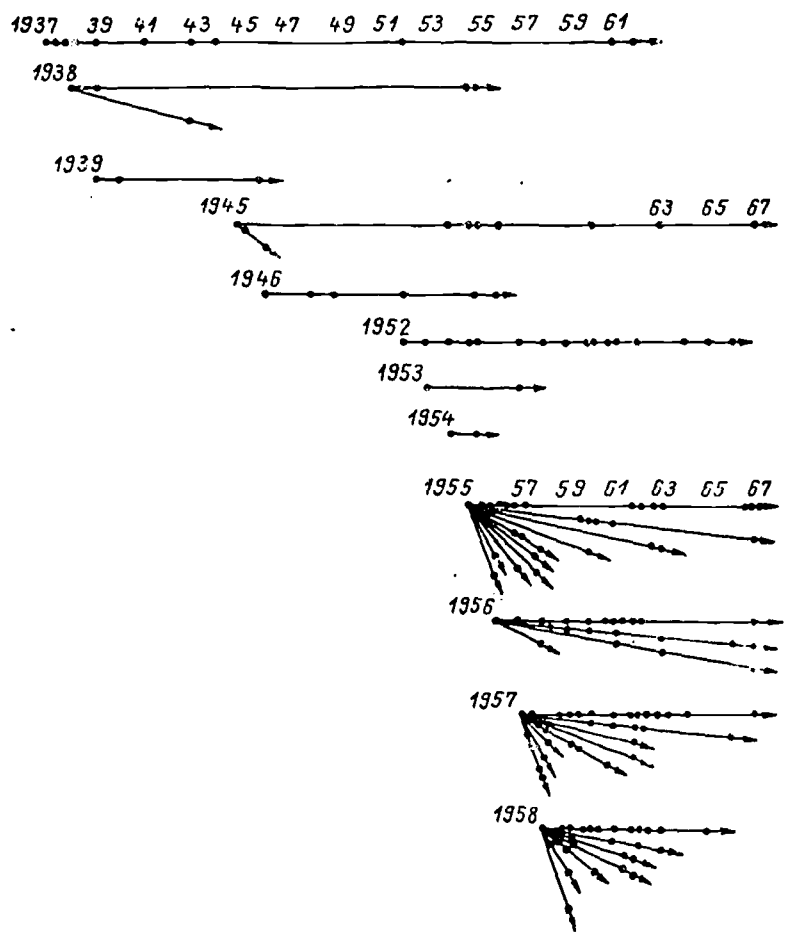

Fig. 2

Fragment of the graph of co-authors of scientist No. 1

grows, the number of his co-authors also grows as shown by short and ramifying clusters. Fig. 4 gives histograms of the durations of collaboration of two Soviet and two foreign authors. The histograms are sharply asymmetri-

cal. A majority of ties is discontinued after the first joint publication, and the number of those surviving more that 10 years is very insignificant. Most contacts survive less than 5 years.

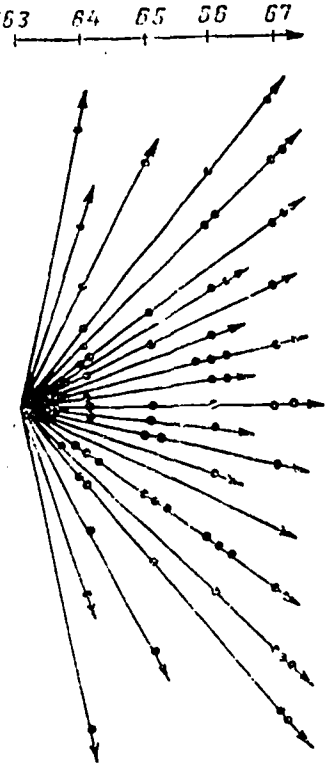

Fig. 3

Fragment of the graph of co-authors of scientist No. 4

Table 3 gives data on average durations of scientific contacts.

These data are obtained from vector graphs of co-authors: the total duration of contacts was divided by the number of co-authors. In plotting the co-authorship graph, only longer-than-one-year creative contacts were

taken into account. It seems of use to supplement Table 3 with the data on the number of co-authors of some scientists for contacts shorter than a year:

Code No. of scientist	Number of co-authors
2	73
4	57
6	96

We shall refer to this form of organization of scientific work as «ephemeron teamwork».

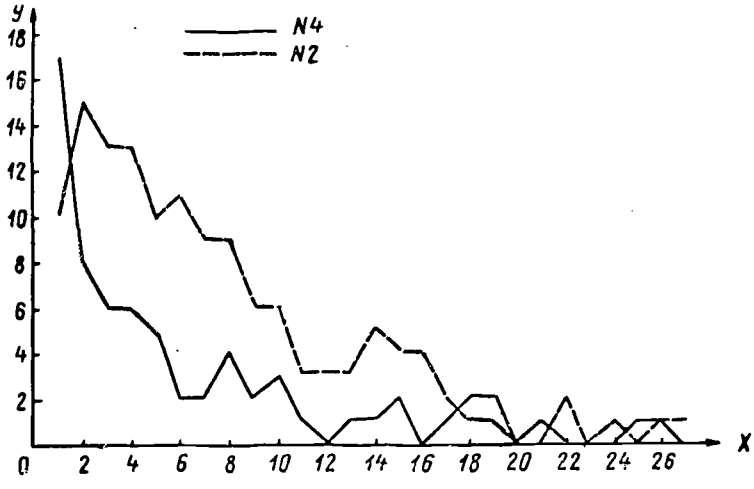

Fig. 4

Histogram of the length of co-authorship period:
y — number of personalized co-authors, x — length of co-authorship period (years), (a) Soviet authors; (b) Foreign authors

Now for the citation rates of chemical authors. Table 4 gives these rates of Soviet chemists according to «Science Citation Index». Data for 2.5 years were considered (1965, 1966, and first half of 1967). The citation data are given as annual averages. The individual citation rates are very high for the sample group — from 30

to 350, with an average of 143 citations per year. For reference, let us point out that the average citation rate of a paper covered in SCI for 1965 was 1.65, and that of an author 5.8. Nobel Prize winners (prior to award of the Nobel Prize) were cited on the average 169 times a year according to SCI; leading scientists in genetic code studies 112, and their co-authors 42.5 times.

As regards the specific citation rate of a publication (i. e. the total number of citations divided by the total number of publications by the same author), the average specific citation rate for the sample group was quite different-1.6 (with a scattering of 0.6 to 2.7).

The specific citation rates of Soviet chemical authors are tabulated as follows:

Scientist's Code No.	Specific citation rate of the scientist's publication	Specific citation rate of a journal publication
1	0.69	0.60
2	0.64	0.40
3	1.10	0.48
4	1.33	1.86
5	2.74	1.87

We studied specific citation rates of the publications of Soviet authors by the years of publication. Curiously, the citation graphs did not have the usual exponential decline which characterizes the obsolesence of the publications. Assuming that the obsolesence factor must have been at play, nevertheless, it must be deduced that the earlier works of the sample group of authors seem to

Scientist	1966 data			
	Papers cited	Total references to papers	Monographs cited	Total references to monographs
Butlerov A. M.	8	8	0	0
Zelinsky N. D.	41	48	0	0
Kablukov I. A.	1	1	0	0
Mendeleyev D. I.	1	3	6	5

have affected the information flow dynamics more than their later works written in company with a greater number of co-authors. It may be hypothesized that the earlier paper were **pioneering** in conceptual plane whereas the later ones were mere elaborations of earlier concepts in application to new material.

This may be corroborated by the following interesting data. SCI of 1966 still gives citations of Russian classical authors of the end of the 19th and beginning of the 20th century. These data are tabulated thus:

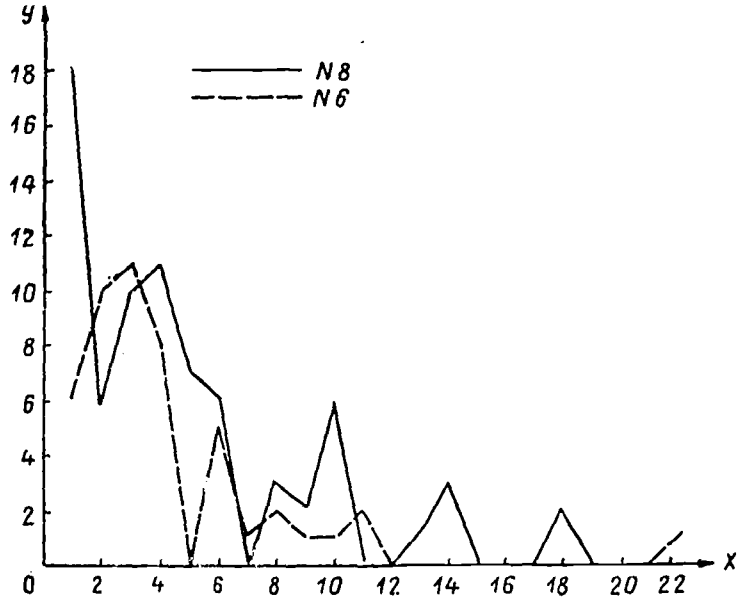

Fig.5

Specific citation rates of periodical papers of three Soviet authors

3. Information activity of physical authors. In the domain of physics (notably, low-temperature physics) the general picture of organization of scientific activities and the formation of research teams is altogether different. Table 5 gives data describing the informational activity of a group of physical authors (four theoretical physicists, and four experimental physicists). The following findings are worthy of note: a relatively small number of

publications per year — from 1.7 to 3.7 (as compared with 4 to 19 of chemical authors) and a small number of coauthors. On the average, about a half of physical publications lack joint authorship. The number of nonpersonalized coauthors in this field of knowledge is by far lower than that in some fields in chemistry (on the average it is about 30; only in one case it was 101); for chemists it ranges from 100 to 1.305.

Stable and long-lived creative ties are typical of physicists. Table 6 shows that, for the most part, the period of joint authorship does not exceed seven years, while in some cases longer periods are observed: 15, 16 and even 19 years. In the period under study, 61 per cent of cases of joint authorship did not survive a year.

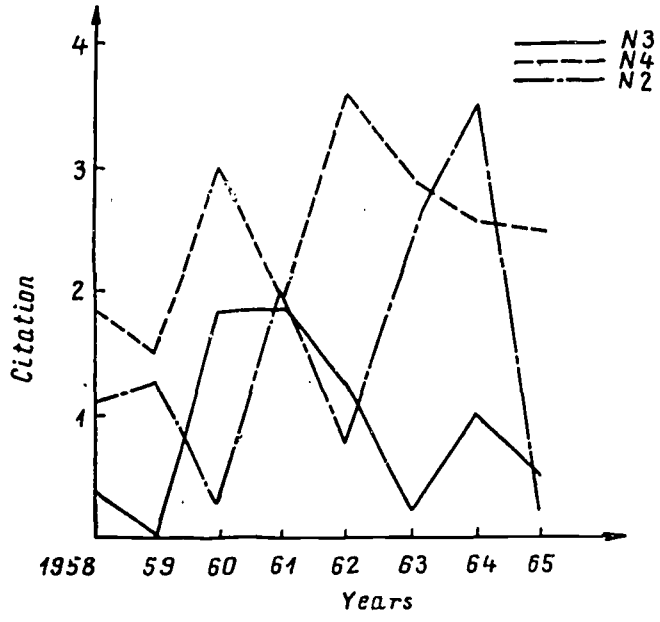

Fig. 6

Co-authorship graphs of an experimental physicist (Code No. 5). The length of the graph indicates the length of creative co-authorship period, and the dots on the graph show the number of joint publications with the co-author

It may be supposed that a scientist as a leader and member of a scientific school prefers individual research but recruits the help of a few short-term (occasional) collaborators, or else that he works with a stable — not mobile — research team. It would be premature to speak of «ephemeron teams» in this case, which are just inceptive. The work of physical scientists does not resemble a production-line process (as mentioned, the annual number of publications varies between 1.7 and 3.7). This suggests the prevalence of conventional organization pattern in the physical field concerned. However, a tendency for transition to new forms of creation of large «ephemeron teams» — is observed for some experimental physicists (cf. Fig. 6), even though it is not so obvious as in chemistry. In this case, an abrupt uprise of the personalized co-authorship is observed in the later years of a scientists's joint creativity. For instance, in 1960 one scientis had six co-authors, and retained the contact with one of them until 1964 (two more joint publications) and with another until 1966 (four joint publications more).

In 1966, author No. 2 issued a publication jointly with six co-authors, and in 1967 with 3 co-authors. At the beginning of creative activity, he had at most 3 co-authors, the period of creative collaboration being for some of them as long as 10 to 14 years.

No similar trend for the growth of the prestige of the «manager-scientist» has been observed thus far for theoretical physics. The productivity of co-authorship, measured by the number of joint publications during the co-authorship period, is rather high. Fig. 7 presents the vector graph of co-authorship of a world-renowned physicist, Lenin Prize winner. Through the period of co-authorship with a colleague he issued 21 publications. The productivity of creative ties with other co-authors was mostly higher than three publications in a year.

These traditional forms of scientific teamwork with small number of co-authors do not forebode the emergence of «intellectual industry» [4]. Production-line forms of endeavour with a large-scale employment of «ephemeron teams» arise in those fields of knowledge where the generation of information has acquired an extensive character and is «breadth-wise», and where the research process is aimed largely at production of new information. In the

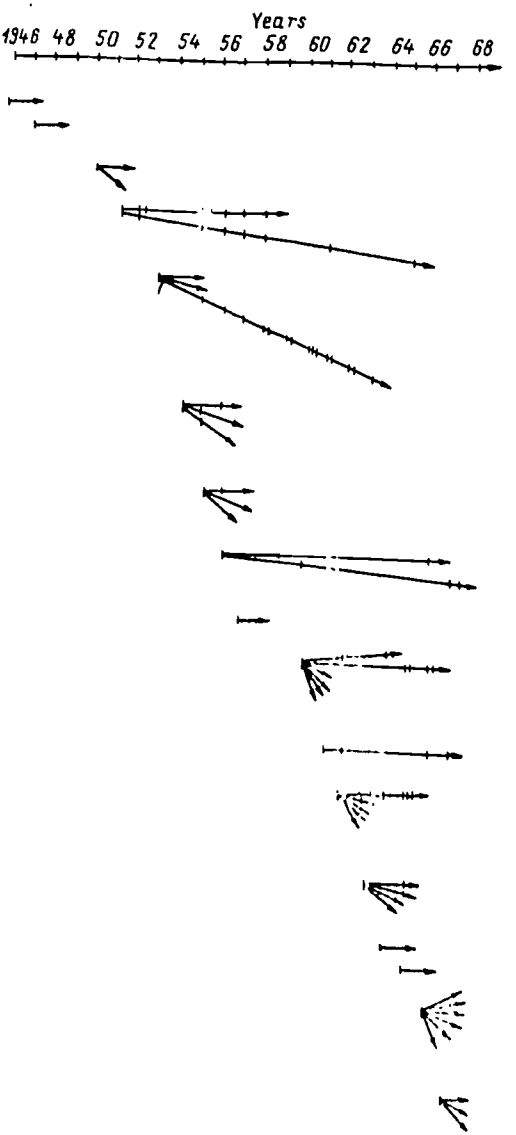

Fig. 7

Co-authorship graph of a theoretical physicist (Code No. 1)

case of the physicists under study we have rather a different type of information activity, embodied in so-called **background** publications, going «depthwise». This can be easily traced by analyzing the contributions of the sample group to world information flows, as expressed by citation rates. Table 7 gives these data for 2.5 years according to SCI. The data in the Table have been averaged by the year. Self-citation was not excluded.

For comparison we studied also citation rates of eminent foreign physicists (theoreticians: G. Bardin and P. Anderson; and experimental physicists: G. Shoenberg and K. Mendelsohn). Lacking the necessary bibliographical information on these authors, we give only data on their citation rates according to SCI*.

Remarkable is the great difference of response to the publications by these authors in Soviet and Foreign journals.

The relatively low citation rate of these authors in Soviet physical publications is not due to a lower level of the foreign physicists (e. g., G. Bardin is Nobel Prize winner), but to the fact that more physicists abroad work in this field than in the Soviet Union.

Scientist	Number of citations in Soviet publications	Number of citations in foreign publications	Average citation rate of a publication of the author
Anderson, P.	35	414	5.7
Bardin, G.	35	353	6.8
Mendelsohn, K.	7	96	2.0
Shoenberg, D.	4	50	4.5

The difference in responses to theoretical and to experimental publications both for Soviet and Foreign authors is also conspicuous. Theoretical papers are usually more frequently cited than experimental ones.

* The technique of citation rate evaluation was the same as for Soviet authors.

Self-citation is quite low for the sample group of physicists — an average of 1.2%. In particular, authors coded by Nos 1, 2, 5, almost completely abstain from self-citations. This may be due to the fact that in the period under study these scientists changed their subject profiles (between 1965 and 1967).

We give histograms of the distribution of citation ra — rates of the publications of a number of authors, where world flow responses to idea-rich publications is clearly traceable. Of interest is the histogram of citation rates of a well known scientist, Lenin Prize winner (No. 1), given on Fig. 8.* Against the almost zero citation rate of

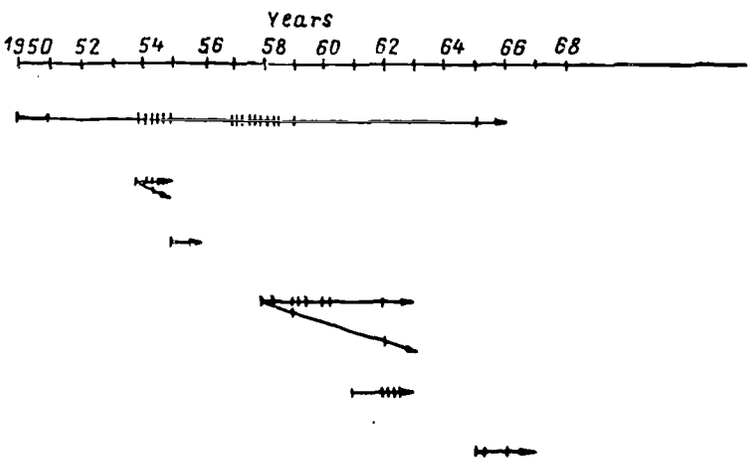

Fig. 8

Histogram of the distribution of the number of references to publications of author No. 1 by publication years

the scientist's early publications, an abrupt upblaze of citations of 1957 publications is observed. This is due to the appearance of a paper on superconductive alloys in 1957 which brought a new concept of some properties of su-

* Histograms account only for journal papers, disregarding the monographs.

perconductors and proved the possibility of their practical application.

Fig. 9 presents the histogram of citation rate distribution of the publications by a Nobel Prize winner, a world

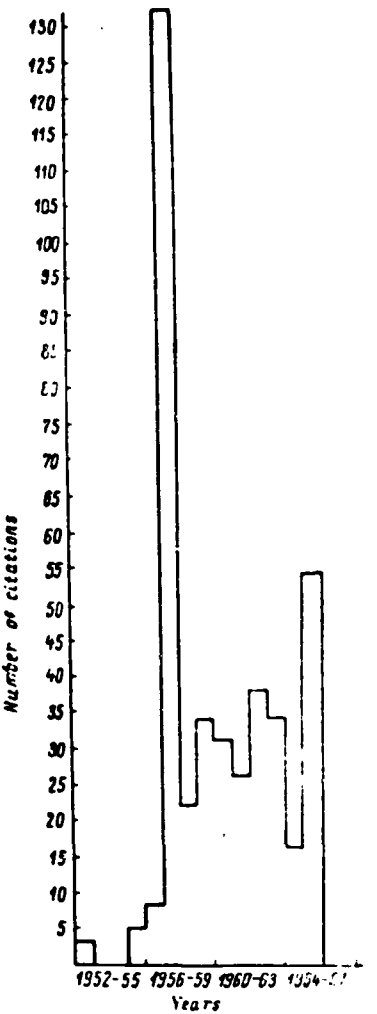

Fig. 9

Distribution histogram of the number of references to publications of the author No. 1 by publication years

renowned author, by the publication years. Starting with 1935, almost every paper by that author was an impetus to development and reappraisal of new physical ideas.

For comparison, here are annual averages of citation rates and information activity characteristics of the two author groups-physicists and chemists*:

	Physicists	Chemists
Average number of publications by an author per year	2.62	10.2
Average citation rate of a publication	6.18	—
Specific citation rate of a publication	6.04	1.3
Average citation rate of a journal paper	3.72	0.95
Average citation rate of a monograph	18.22	—
Average number of references to an author per year	105.8	141

The information activity of characteristics for low-temperature phisics and for chemists differ substantially which is evidence of the differing organization patterns of this activity in the two fields.

4. Conclusion

1. The scientometric analysis described in the paper revealed the existence of a new organizational form of research. Until now, two such organizational forms were usually distinguished—scientific schools and «invisible colleges». A tendency is now observed for the emergence of a third form—production-line, almost industrial, procedure for the generation of new information by setting up so-called «ephermeron teams». An ephemeron team is headed by an eminent scientist who advances new ideas and also functions as a science manager. He is surrounded, on the one hand, by a small permanent staff — a traditional scientific school, and on the other hand, a group of ephemeron collaborators that is coauthors with a short joint authorship period. These are obviously postgraduate students, junior research staff working on probation, students writing diploma papers. A curious overlap of research and educational work takes place on an unprece-

* Only data for Soviet authors were taken into account in this case.

dented scale. As the prestige of the manager-scientist grows, he becomes surrounded by a growing retinue of ephemeron co-authors.

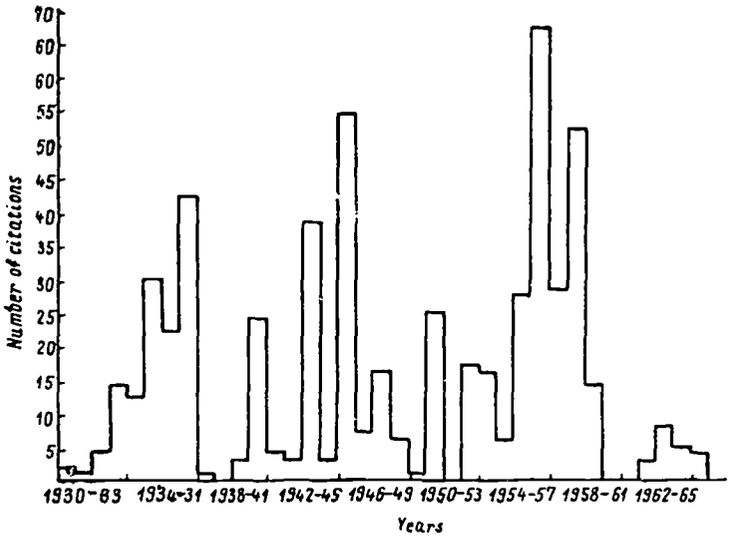

Fig. 10

2. The above trend seems to be typical of certain fields of knowledge and at any rate it is not due to organization of science in this or that country. Along with this new organizational form, traditional forms survive in another field (low-temperature physics), with leading scientists publishing comparatively few papers and having rather few co-authors.

3. The production-line industrial research processes based on a large-scale use of ephemeron teams give rise to publications that can be classified after Yu. Shreider & Osipova [4] as products of «intellectual industry», in contrast to publications of the sample group of physical authors concerned with searching and developing substantially new ideas. The former type of publication carries information which is «breadth-wise», extensive-studying (or synthesizing) even new objects and processes from previously developed backgound positions; this

Table 1

Information Activity of Chemical Authors

Authors		Length of research activity (years)	Total publications	Annual average publications	Personalized coauthors	Nonpersonalized coauthors	Average co-authors per publication	Doubling time of the number of co-authors (years)	Doubling time of publications number (years)
Codes of chemical authors	Soviet scientists 1	33	347	91.3	123	333	0.96	4.9	5.7
	2	43	432	10.05	206	344	0.97	5.7	6.0
	3	15	223	4.96	63	100	0.45	13.9	6.1
	4	39	755	19.36	125	1305	1.73	4.1	4.1
	5	51	332	6.51	105	279	0.84	6.6	8.1
	Foreigh scientists 6	32	304	9.50	188	321	1.06	3.7	4.1
	7	18	106	5.61	41	107	1.00	7.9	3.6
	8	29	307	10.59	166	472	1.54	3.4	4.4
	9	40	154	3.85	101	317	2.06	6.8	7.9
	10	35	283	8.09	41	318	1.12	7.5	8.4
	Mendeleyev D. I.	53	352	6.64	1	7	0.02	—	9.2
	Butlerov A. M.	39	418	10.71	7	42	0.10	4.6	5.3
	Kablukov I. A.	63	198	3.20	24	36	0.18	12.2	11.7
	Zelinsky N. D.	61	474	7.77	129	354	0.75	10.9	9.4

Table 2

Peak Information Activity Years of Chemical Authors

Authors	Maximum publications year		Maximum co-authorship year	
	(age of author in brackets)	Number of publications	Age of author that year	Number of co-authors
1	1962 /59/	34	1962 /59/	52
2	1956 /58/	22	1957 /59/	23
3	1928 /32/	13	1926 /30/	8
4	1959 /60/	55	1959 /60/	124
5	1957 /62/	14	1964 /69/	21
6	1948	19	1954	47
7	1958	12	1955	13
8	1955	31	1958	54
9	1954	13	1952	17
10	1960	42	1960	49
Mendeleyev D. I.	1870 /36/	20	—	—
	1875 /41/	21	—	—
	1892 /58/	19	—	—
Butlerov A. M.	1873 /45/	38	1873 /45/	6
Kablukov I. A.	1926 /69/	32	1909 /52/	7
Zelinsky N. D.	1909 /41/	29	1941 /80/	30

distinguishes them from publications of the other type, going «depth-wise», with new ideas arising not from generalizations of ample (sometimes similar) data, but from new problem statement or the staging of new, refined, experiments.

4. Specific citation rate is a criterion permitting to distinguish the publications of the «intellectual industry» from pioneering and idea-rich publications. Intellectual industry documents can be fused together into summary papers or monographs characterized by high citation rates. Unlike his specific citation rate, the general citation rate of an author can be equally high for a manager-scientist working for the «intellectual industry» and for the scholars concerned with deep-going research.

In conclusion, we are pleased to acknowledge our gratitude to V. V. Nalimov for suggesting the subject of this study and evincing live interest in its course.

Table 3

Average Period of Co-Authorship

Authors	Average collaboration period (years), disregarding contacts shorter than 1 year)	Taking into account contacts 1 year
1	4.3	2.1
2	7.4	4.8
3	7.8	2.5
4	6.4	3.3
5	8.6	3.8
6	4.3	1.4
7	3.2	1.6
8	4.9	1.7
9	3.6	1.6
10	5.0	2.2
average	6.9 Soviet	3.5
mean-square error	3.3 authors	1.19
average	4.2	1.7
mean-square error	0.6	0.09
Butlerov A. M.	5.6	4.0
Kablukov I. A.	3.8	0.8
Zelinsky N. D.	5.0	2.4

Table 4

Citation Rates of Soviet Chemical Authors According to SCI: 1965, 1966 and 1967

Code of author	Number of references to monographs in years:			Number of references to papers in years:			Average citation per year
	1965	1966	1967	1965	1966	1967*	
1	9	2	7	73	80	79	78
2	42	9	15	73	58	76	68
3	83	55	68	35	30	22	30
4	2	16	17	205	166	171	183
5	11	11	9	229	438	207	348

* Data for 0.5 year were counted for 1967. In averaging the results, these data were assigned the «weight» of 0,5 and the remaining data weight of 1.0.

Table 5

Information Activity of Societ Phsycal Authors

Code of author	Length of research activity (years)	Total publications	Annual average publications	Personalized co-authors	Nonpersonalized co-authors	Average co-authors per publications	Publications written without co-authors (percentages of total publications given in brackets)
1	17	63	3.7	8	43	0.7	32 (50%)
2	24	83	3.5	17	53	0.8	35 (39%)
3	10	34	3.4	11	28	0.8	32 (35%)
4	27	42	1.6	8	29	0.7	14 (35%)
5	54	90	1.7	12	25	0.3	73 (39%)
6	29	83	2.9	45	101	1.2	21 (25%)
7	10	20	2.0	10	21	1.1	6 (30%)
8	26	56	2.2	11	20	0.4	41 (70%)

Table 6

Period of Creative Collaboration (Co-Authorship Time) for Physical Authors

Duration of contact (years)	Number of co-authors for scientists No.				Number of co-authors			
	1	2	3	4	5	6	7	8
1	4	11	4	4	10	29	6	9
1	1	0	0	0	1	4	0	0
2	0	1	1	0	0	3	0	0
3	0	1	1	0	0	1	3	1
4	2	1	2	2	0	1	0	0
5	0	0	0	0	0	1	0	0
6	0	0	1	0	0	2	0	0
7	0	1	1	1	0	2	1	0
8	0	1	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	1	0	0
11	0	0	0	0	0	1	0	1
15	1	0	0	0	1	0	0	0
16	0	0	0	1	0	0	0	0
17	0	1	0	0	0	0	0	0

Table 7

Citation Rates of Scientists of the Institute of Physical Problems of the USSR Academy of Sciences (based on SCI)

Authors	Citation rates of journal publications in soviet and foreign sources	Average number of reference to publications	Average citation rate of monographs	Average number of references to a publication of the author	Specific citation rate of the author's publication*
1	413	13.33	40.79	14.28	14.28
2	489	6.58	59.74	13.55	15
3	63	2.78	—	2.78	1.5
4	83	2.22	53.05	9.10	10.4
5	89	2.5	2.30	2.49	1.61
6	86	2.02	—	2.02	1.04
7	62	3.38	—	3.38	3.10
8	54	1.86	—	1.86	1.30

* Average citation rate is measured by the ratio of the total number of references to a group of publications cited to the number of publications in this group. The averaging of ratios for 2,5 years involved «weighting»: the «weights» of 1 (for a year) and of 0,5 (for half-year) were taken.

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T. M. Pachevskij
(USSR)

THE STUDY OF SPECIALISTS' INFORMATION NEEDS AS A PRECONDITION FOR AND A MEANS OF INFORMATION SYSTEM STREAMLINING

The 1960's saw a tremendous growth in research and publications devoted to the study of information needs and interests of specialists. According to very rough estimates, more than 500 relevant papers have appeared in the last 10 or 12 years.

This fact could be welcomed if it were not for two circumstances. With many librarians and information scientists information need studies have become almost an end in itself. Various aspects of information users have been investigated without a clear idea of the purpose of elucidating particular facts. Study objectives have in most cases been stated in very general terms and have not specified all the aspects of the methodology and content of the work done.

Low methodological standards is another deficiency of much of the work conducted in this field.

M. Line was quite right writing in his monograph [1] that even a small methodological oversight is bound to bring to nought all the findings of a survey.

As aptly noted by Soviet information scientists A. I. Mikhailov and R. S. Gilayrevskij, neither domestic nor foreign information need studies «rely on a generally accepted methodology and their findings are comparable to a very limited extent» [2]. This in not surprising considering that a fully satisfactory and general methodology is simply nonexistent today.

But the situation is not as bleak as it may look at first sight. Thus, one notes with satisfaction that fewer and fewer studies rely entirely on «cases», as it was in a not too distant past. A case can only specify a salient

point or it can furnish the basis for advancing a sound hypothesis but it cannot prove anything, for one can secure a case for any situation, both a lawful and an exceptional one. «Selecting chance examples presents no difficulty at all, but is of no value, or of purely negative value ...», wrote V. I. Lenin in his «Statistics and sociology»*. This is now realised by many librarians and information scientists, which explains their searches for more exact and objectve research techniques, for the application of quantitative methods in conjunction with qualitative analysis, and the trend in many studies to use methodologies borrowed from other disciplines (the science of science, mathematics, sociology, psychology).

However, the apparent simplicity and facility of such sociological techniques and questionnaires and interviews has led to a large number of superficial studies that hypnotise the reader with their sham «scientific» looks. Incorrect application of sociological and statistical techniques is even more detrimental to science than the recent vogue for «cases», in view of the current excessive reliance on statistics data. Besides, the study of information requests becomes an end in itself.

We consider it to be essentially wrong to regard the study of information needs, requests, and interests of specialist as an independent line of research in library science and informatics. The study of these aspects is not an objective but a means of and a precondition for streamlining the system of information service to specialists. Considering as we do the proper direction** of information work to be essential to its effectiveness, we have concentrated our efforts on identifying the optimal direction of the information-bibligraphic activities of a major information system component represented by the general research library serving a large region.

Investigating this problem on the basis of surveys of specialists in chemistry, physics, geology and other sciences seemed almost as pointless as conducting a questionnaire survey among librarians on problems of physics, chemistry, geology... Each method has its own limita-

* Ленин В. И. Статистика и социология. Полн. собр. соч., т. 30, стр. 349—356

** This term is taken to mean the unity of the content and form of information.

tions and scope. The authenticity of survey findings of factual nature depends on the proper selection of the sample. As far as problem questions are concerned, posing them in a survey is inadmissible in principle. To illustrate, one can collect a great number of specialists' responses to the question «What is your idea of an ideal information system?» but the data obtained in this way will be practically of no value at all, and the matter will not become any clearer than before the survey. Among the mass of incidental, subjective and superficial answers, occasional deep comments and suggestions will possibly be found which may serve to advance a hypothesis, but not to solve a problem.

Thus, the present author has failed completely in his attempt to make a questionnaire survey of specialists in order to clear out their opinion on the desirability of establishing a regional abstracting service. This problem was discussed in our paper [3] reporting on an experiment to explore the use of VINITI abstract journals by specialists. As we believed that the experimental data was not conclusive enough, we decided to complement it with questionnaire survey data. Wishing to avoid any bias in the respondents' views, the author tried to devise the questionnaire form in such a way as to leave his own position obscure.

A preliminary analysis of the data indicates that it can be used to support any point of view. The argumentation of the respondents favouring the institution of a Siberian abstract journal was in most cases as little convincing as the argumentation of those who expressed a negative point of view. The fact that the majority of the respondents have favoured a Siberian abstract journal does not prove anything, as an analysis of their answers reveals their utter subjectivity and a lack of expertise in this matter. You can increase the sample ad infinitum, even make it as large as the general totality, and then process the data on a computer, but even this will not make the material of any value for problem solving. Such a survey may even play a negative part as it creates the illusion of a research study. We do not regard, however, the questionnaire survey as wholly useless, for the very fact of a psychologically positive attitude of the majority of specialists to the establishment of a regional abstrac-

ting service was itself of value to us.* We shall also take into consideration some of the more interesting comments of specialists on these matters.

An essential point in studying the information needs of specialists is to use a methodology that will make it possible to find out the actual needs, not the scientists' subjective views of their information needs. For this reason, even at an early stage in our research study aimed at establishing an optimal course of information-bibliographic activities of a general research library, an experimental methodology was devised in order to arrive at relatively sound and multiform results. The methodology was developed in 1965 and first reported at a conference in Novosibirsk in 1966 [3]. The gist of the experiment is as follows: a specialist is offered a subscription to some indexing publication on condition that, while looking it through, he must tick off the items which are of interest to him and of which he has not had any previous knowledge. The serial numbers of the marked papers in each issue of the indexing bulletin are mailed by the user throughout the year. The publications marked by the specialists are analysed from various aspects. In a similar way, the indexing bulletins themselves are analysed and the findings of both these analyses are compared. The experimental data are also used for determining the effectiveness of information.**

This experimental methodology possesses several merits the most important of which is that the study was conducted in an operating environment. A serious drawback of a closely related anglo-american experiment reported two years later by Keenan and Slater [5] is the fact that the experimental findings were obtained not in a natural environment of using an information source by specialists, but from circulating an issue of «Current Papers in Physics» expressly for the purpose in their study.

The exprimental data were used for ascertaining the influence of classification, selection, annotating and other factors of information efficiency. A bibliographic method

* However, hundreds of specialists did not have to be interviewed to establish this fact.

** For a detailed description of the methodology of the experiment and the calculation of the efficiency of information publications, see [4].

for establishing the extent of integration of sciences has been devised from the findings of this experiment. And lastly, the quantitative data of the experiment were used in calculating information efficiency by the methods and formulas proposed in [4]. The efficiency indicators of various types of bibliographic publications compared with the questionnaire and interview data have given ground for valid conclusions concerning the optimal direction of information work.

The histogram given below indicates the effectiveness of the regional current bibliographic indexes issued by

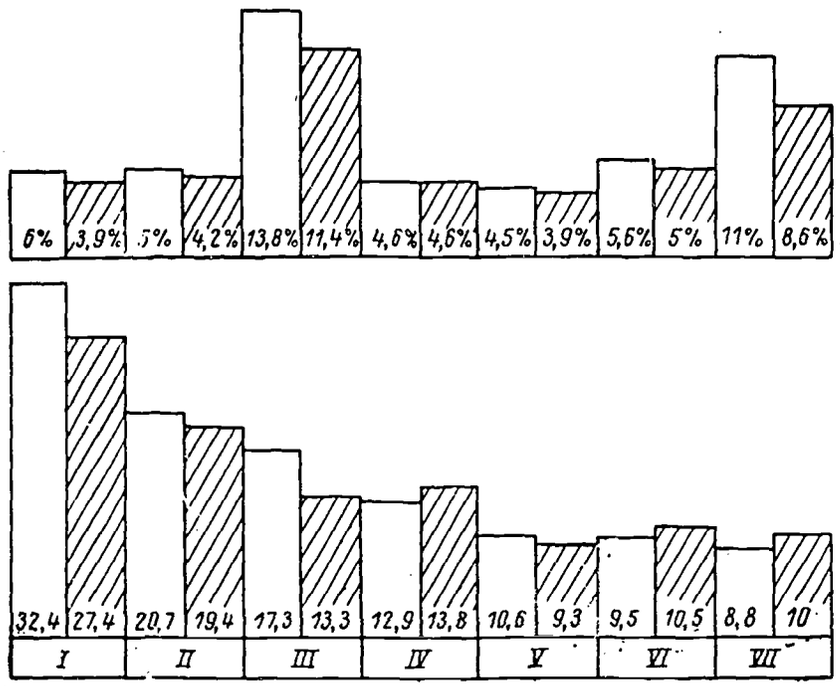

Fig. 1

the State Public Library for Science and Technology, Siberian Division of the USSR Academy of Sciences (Fig. 1). In order to establish the extent of the accuracy of the method used we calculated Ea (absolute efficiency) and

Er (relative efficiency)* based on the data for a quarter of a year and for a year. As can be seen from the histogram below, the discrepancies in the values of Ea and Er are relatively insignificant, when the experiment lasts either a year or three months an tany rate they do not permit any conclusions on the effectiveness of information-bibiliographic bulletins to be drawn other than those derived from the analysis of the data for a quater of the year.**

The effectiveness indicators of an information publication refer both to its quality standard and to the information support of the given field or topic by other information sources, and a number of other factors.

As indicated by the findings of the experiment, questionnaire survey and interviewing, the effectiveness of bibliographic indexes covering the literature on the natural conditions, history and economics of a region is certainly influenced by the significance of the regional factor for a particular subject field. It is not by chance that the highest effectiveness indicators were displayed by soil science, geology, zoology and history bulletins. The data of surveys of specialists and the findings of the study on their use of abstract journals indicate that regional material is of particular value for researchers in these fields. Thus, 20% of all those who responded to the question «What is in your opinion the principal merit of the given information publication?» answered «Its regionality». It was the highest coincidence rate of answers to this open question of the questionnaire.***

Research workers of Siberia and the Far East were interviewed in order to find out the significance and role of regional and local study publications in their information support. The interview findings are given in the diagram shown in Fig. 2.

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* A substantiation of Ea and Er is given in the previously mentioned paper [4].

** The histogram presents comparative indicators for the first quarter and the mean data for a quarter calculated from the data for the year.

*** The survey covered 283 subscribers to the regional bulletins issued by the State Public Library for Science and Technology, Siberian Division, USSR Academy of Sciences. The value of the regional principle was emphasised mainly by the geologists, soil scientists, geobotanists, zoologists and historians.

The diagram reveals that 19.4% (14.5% + 4.9%) of all the reference information is obtained by Siberian scientists from regional bulletins. Therefore, for this category

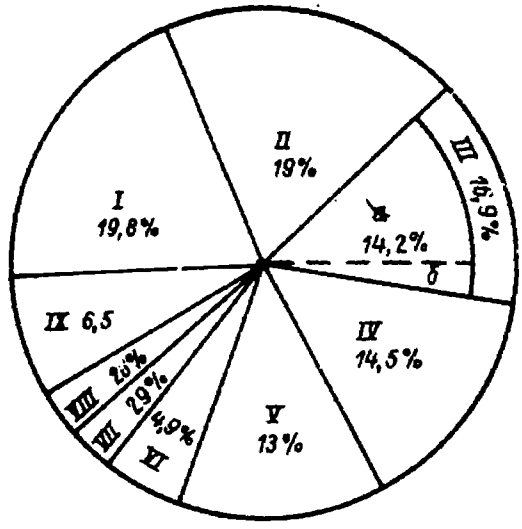

Fig. 2

of specialists regional bulletins represent one of the principal information sources. The special significance of regional publications for specialists in the majority of subject fields studying a particular region must not be overlooked either. It follows from the data obtained that the regional direction should be a leading one in the information activities of a general research library serving a large region.

A good deal has been written recently on the differentiation and integration processes in modern science. The bibliographer and the information scientist are both interested in these processes inasmuch as they shape the information interests and needs of specialists and, consequently, influence information activities. The information system that has now established itself throughout the world is essentially discipline-oriented, i. e. is a manifestation of the differentiation of sciences. Meanwhile, the integration of sciences gives rise to new and special information requirements which cannot be met satisfactori-

ly within the framework of the existing disciplinary and highly specialized information. This accounts for the emergence of a basically new phenomenon — problem-oriented bibliographic information designed to provide for the information needs of specialists working in multidisciplinary and fringe subject areas.

Using the above-mentioned experimental methodology, we have investigated the use rate of the various information-bibliographic indexes issued by the State Public Library for Science and Technology, Siberian Division,

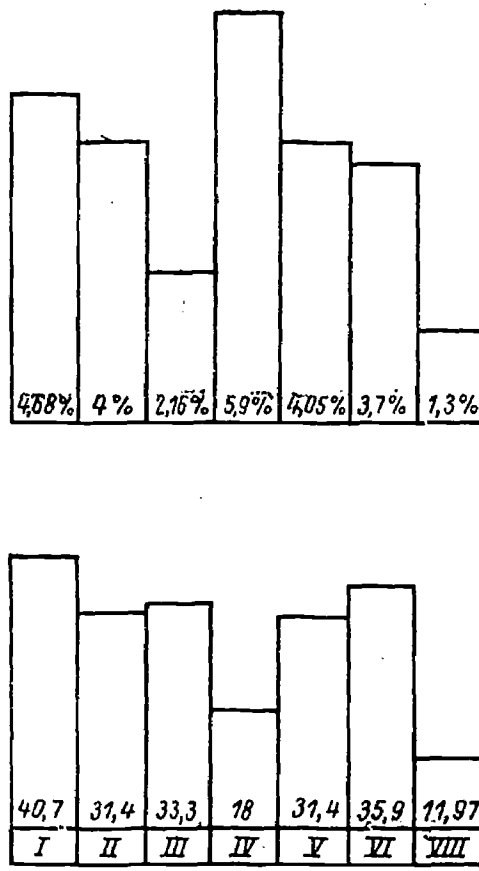

Fig. 3

USSR Academy of Sciences. The data on the effectiveness of problem-oriented (I, II, III, IV, VI), a highly specialised (V) and a disciplinary (VII) bibliographic bulletins are presented in the histogram (Fig. 3).

The case for the typification of the above bibliographic publications, according to the extent and character of integration of the corresponding sciences, is presented in paper [6].

The discrepancies in the effectiveness indicators of current information indexes of the same kind, such as the multidisciplinary bulletins «Bionics» and «Economic and sociological applications of mathematical techniques», are in most cases due to their compilation methodologies, especially as regards the selection of the material. An insignificantly higher Ea of the second bulletin is partly accounted for by the coverage of many unimportant publications, as the Er of this bulletin is twice as low as that of the «Bionics» bulletin.

The information publication type and its place within an information system has a decisive effect on its effectiveness. The histogram shows that the Ea of the highly specialised bulletin «Rock mechanics» is 174% lower than that of the problem-oriented bulletin «Opencasting».

Clearly, a somewhat higher value of the Er of the «Rock mechanics» bulletin is primarily the result of its nearly three time as narrow coverage of the literature as in the problem-oriented index (1214 and 3094 publications a year, respectively).

Even more suggestive are the comparative data of the effectiveness of two bulletins: a problem-oriented chemical bulletin, «Extraction. Ion exchange», and a disciplinary one, «Chemistry and chemical engineering». The second bulletin's Ea and Er are three times as low as those of the first one. Considering that both these chemical indexes were prepared by the same bibliographers and that equally high bibliographical standards were maintained, there cannot be any other explanation for such large discrepancies in the effectiveness of the two publications other than those inherent in their very nature.* «Extraction. Ion exchange» is a problem-oriented information

* According to the formula for Er given in [4], it is expressed by the ratio of Ea to L, where L is the number of publications covered by an information publication over a certain time period.

publication, in which the entire range of methodologies used, and above all the classification of the material, are subordinated to the task of identification and bringing to the attention of the user all the material on this problem. Material on extraction is scattered among many highly specialised divisions of the disciplinary abstract journal «Chemistry», and for this reason some part of extraction information remains unidentified by the abstract journal and thus unused.

The foregoing experimental data are in good agreement with the findings of the interviewing conducted in 1967 in the library reading rooms of four chemical institutes of the Siberian Division, USSR Academy of Sciences, based on the questionnaire proposed by us. Thus, an average of 14.55% of all information on publications of interest to the chemical specialists was obtained from the various information-bibliographic bulletins of the State Public Library for Science and Technology of the Siberi-

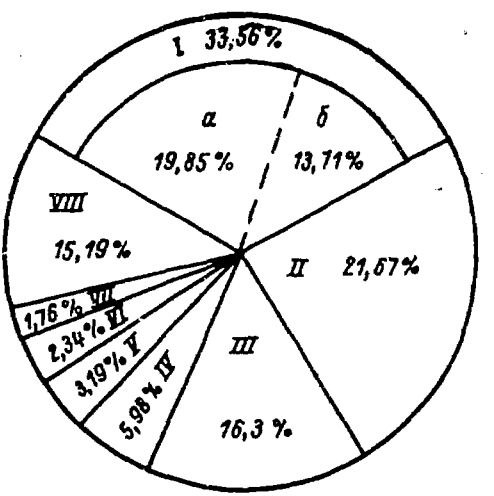

Fig. 4

I — Abstract journals
(a) domestic; (b) foreign
II — Bibliography at the end of books and articles III — Journal bibliography IV — Library cataloques V — Information-bibliographic bulletin «Chemistry and chemical engineering» VI — «Book annals» and «Journal paper annals» VII — Retrospective bibliography VIII — Other information sources

an Division, and only 3.19% of information, from the «Chemistry and chemical engineering» bulletin.* (See diagrams in Figs 2 and 4).

The data leads to the conclusion that there are no sufficiently valid reasons for research libraries to provide disciplinary (and highly specialised) information.** Research libraries' efforts should be concentrated on problem-oriented information for those problem areas for which an efficient information service cannot be ensured within the framework of disciplinary information publications.

The study of information intersts and needs of specialists and the effectiveness of use of information sources has led to the following conclusions:

A total approach to the study of large regions has become a major feature of the present-day science, which has stimulated a special interest in regional literature on the part of subject specialists. Effective provision for the needs of specialists for regional and local information has become one of the main prerequisites for the development of science in Siberia and the Far East.

The proper direction of information work is a crucial factor in its effectivenes. The methodology of secondary information production will have a serious effect on its effectiveness only if an optimally right direction of an information centre's activities is found. This can be achieved only if due account is taken of the trends in the development of science, and a thorough and comprehensive study is made of the interests and needs of specialists working within the region, as well as the information links and information support for each discipline, problem area, or topic. All these matters must be dealt with both on a national and a regional level.

Effective meeting of the various information needs of various user categories is only possible through a special system of information publications varying in purpose and user orientation and, hence, methodology. An

* Preliminary processing of the experimental and questionnaire data led to the decision to discontinue in March 1968 the publication of «Chemistry and chemical engineering». At the same time, theproblem- oriented bulletin «Extraction. Ion exchange» was started.

** This conclusion does not apply, of course, to the appropriate industrial ministries as well as disciplinary regional information.

optimal information system can be built only on the basis of differentiation and polarisation of demands placed on the different system components. Only the specificity of each component and the orientation of the methodology towards the maximum possible satisfaction of the information needs of particular user categories can serve as the groundwork for the efficiency of the system generally as well as its individual components and publications.

The optimal direction of the information activities of a general research library serving a large region must be composed of two basic components:

1. Current regional and local information (of all types).
2. Current problem-oriented (non-regional) information.*

The first can be established by three components operating in parallel:

(a) regional and local current awareness information (main link in the system);
(b) current abstract regional information;
(c) survey-analytical regional information.

Current problem-oriented information must include:

(a) current-awareness problem-oriented information;
(b) survey-analytical problem-oriented information.

The leading part in this component is played by current-awareness problem-oriented information, especially by inter- and multidisciplinary information. A general research library should forsake the task of providing highly specialised and especially disciplinary information.

Continuous refinement of methodology is essential to the successful development of all the directions of information work outlined above. Indispensable to the improvement of methodology is the development of methodological techniques in organic unity with the purpose and user-orientation of scientific information, on the basis of the study of the information needs of specialists and their use of information sources. Constant user feedback is an important prerequisite for information effectiveness. Only on this basis a truly scientific foundation for increasing

* This conclusion applies to the information activities of any general research library, not only a regional one.

the efficiency of scientific-technical information system can be developed.

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H. Jarecka, I. Aleksandrovicz
(POLAND)

A CONTRIBUTION TO RESEARCH ON INFORMATION USER NEEDS

Introduction into the problem

A user constitutes the last, final link of every information system, and a proper understanding of his needs is a prerequisite of the efficient functioning of the information services.

The recent years have brought a marked increase in research conducted on the needs of reference users, and an extension of the scope of questions included in this type of research. The main objective here is to make work more efficient and to lower the expenditure involved in the preparation of information and work on it. This question has especially gained in importance as a result of the introduction to the reference service of new, computerized and very expensive systems, as well as in connection with work on a universal information system, the UNISIST [23]. So far, the investigations were extended above all to the representatives of sciences and technology [21], but gradually also other groups of users began to be included into the research. The criteria for classification have been as follows: education, the type of discipline, the degree attained in scholarly work, and the functions performed. Now it has been recurrently emphasized that the needs are determined also by the individual user's mental structure, by his working methods and habits acquired in work on information sources, and by the amount of interest taken by him in the work — and that therefore these elements should be also taken into account [4, 18].

Postulates have been also set forth for research on

the individual user's «productivity» which means studying the effectiveness of scholarly work [6].

Investigations are conducted now all over the world, and above all in the Soviet Union [13], in the USA, in the United Kingdom, and in the German Democratic Republic [9].

One can discern three main trends of research [10, 15, 22]:

1) Attempts at determining the applicability of the reference material.

2) Inquiries into the users' own demand for information and the classification of users resulting from it.

3) Inquiries into information services and channels, and into the effectivity of information-conveying systems.

Not so much attention has been devoted to the research methods applied — and this issue seems to be most difficult to solve. Much difficulty is encountered when attempts are made at classifying the users and their needs; the research has also brought to light some disparities in terminology [22].

Of the research methods, it is the questionnaire forms that prevail, as they allow for extending the inquiry to a fairly large number of respondents and for a proper selection of data to serve the purposes of statistical analysis [14]. The questionnaire forms are supplemented with interviews, and the results compared with the experiences obtained by the information staff in their daily work. Records are also made of observations, queries, and the use of reference material, which is considered to be a source more trustworthy than the questionnaire form.

Of late, the problems of information users have been examined recurrently at a great many international conferences. At the Bucharest Symposium of the CMEA [Council of Mutual Economic Assistance] members held in 1968, where the problem of evolving and studying the user needs was discussed, the participants reached the conclusion that the investigation of information needs is highly relevant for the construction of the national scientific information system. The problem was raised again at the 1969 CMEA Conference in Moscow, concerned with the principles of scientific information. Then, the 35th FID Congress held in Buenos Aires in 1970 [4]

was devoted to the question of information users, with the following problems at issue:

1) the introducing of information to users including the problem of its effectiveness and the inquiries into user needs as well as the training of users,

2) the education of users,

3) conventional and non-conventional means in answering the user needs.

The results of the inquiries into user needs presented at the Congress have shown that the most urgent need is to train users in a proper utilization of information sources. Appreciating duly the importance of having the actual and prospective reference users trained, it is postulated that classes on the subject should be introduced into the curriculum of both secondary schools and colleges. Training courses and their programmes are a highly pertinent point, and were discussed at length during the Conference held in Rome in November 1971, and organized by the National Information Institute, with co-operation from the FID [3].

Libraries with long tradition in research conducted on reading, register and record queries and questions and analyse the reference data used, which constitutes a valuable material for the study of user needs.

The West German library researcher E. Sauppe [16] is of the opinion that this type of research should serve as a subject for librarians' dissertations and theses. In the Federal Republic of Germany studies on user sociology are carried [17]; it is emphasized that library work sociology, which can be of help in defining the demands of the different groups of users, should constitute an autonomous discipline in the library science.

In the USSR questionnaire inquiries have been carried lately in 300 libraries of different type in order to prepare effective forms and methods of information service [19].

Also the American libraries conduct intense investigations of reference user needs.

In Poland this kind of research is carried out by the Center of Scientific Documentation and Information at the Polish Academy of Sciences (Ośrodek Dokumentacji i Informacji Naukowej Polskiej Akademii Nauk), and by

the Central Institute of Scientific Technical and Economic Information (Centralny Instytut Informacji Naukowej. Technicznej i Ekonomicznej), converted of late into the Institute of Scientific, Technical, and Economic Information. The research conducted at these institutions is not uniform in character, each of them having its own distinctive features. Thus, the CIINTE is concerned above all with users connected with production and industry (this group can be defined by the generally accepted term of the «engineering staff»). Research conducted at the ODiIN PAN, on the other hand, embraces scientists and have to be extended shortly to a group of persons working on their doctoral theses.

The inquiries at the ODiIN PAN were conducted within a co-operation system on information between the Polish and the Czechoslovak Academies of Sciences [20]. They can be considered as preliminary essays in pooling. They were extended to different groups of research workers, their main ojective being to establish how various reference materials are used. The investigation was conducted by means of questionnaire forms, interviews, and observations made by the reference-service staff. It was carried out at eighteen outposts strictly co-operating with the ODiIN PAN. At a Symposium held at Smolenice near Bratislava — Socialist Republic of Czechoslovakia, where the participants exchanged and summed up their respective experience, also some scientists (as information users) had been invited to take part, which led up to a common discussion and permitted an exchange of opinions between users and the reference service staff.

The inquiries have brought to light the needs of scientists and their unfortunately mistrustful attitude to the information service, as well as their rather scanty interest in the question of scientific information. They have revealed considerable differences in the needs dependent on the respective discipline, and have permitted to detect the existing deficiencies in the information—service activities. They have brought also some experience in the methodology of research. The most conclusive of all the methods of investigation has proved to be the interview, while the questionnaire form has been admitted to be rather a supplementary measure. Inquiries of this type should be treated as a continuous process, with incessant

observation, and now then interviews and questionnaire forms to aid the research.

The investigation carried for about ten years in the CIINTE network [11] follow two directions:

1) Inquiries into the utilization, applicability, and effectiveness of the informaton carrers, worked out by the CIINTE information services.

2) Inquiries into the information needs of chosen user groups and of chosen categories of institutions.

Most of the investigations were conducted by the questionnaire method, as, e. g., the inquiry into the scope of reading and into the usefulness of reference publications, carried out at the Branch Center of Information of the Metal-Cutting Institute in Cracow [1].

The questionnaire distributed in 1967-68 among the directors of industrial plants, and the investigation conducted in 1969 [2], which were to provide an estimate of the information-service activities by the management of industrial plants, have shown that the part of information in production and planning is underestimated. It has been established that the deficiencies in information service are the result of an inadequately prepared and trained staff and of the unsatisfactory condition of the material-and-technical base, and, moreover, of an inadequate perception of the demand for information among diverse categories of users at the given plant. It has been, therefore, considered necessary to brain the plant's information service to undertake studies on user needs at the outposts they have to serve.

Results and experience in research on user needs were exchanged also during the Polish-French meeting on scientific and economic information for industrial needs, organized in Warsaw by the CIINTE and by the Association Nationale de la Recherche Technique and the Centre National de la Recherche Scientifique in May 1967 [12].

In the Polish libraries there has been so far no extensive research on information user needs. An essay in user classification was presented by Mrs. Maria Manteuffel during the Scientific Session of the Polish Librarians' Association, on Information in her report, «Forms and Methods of Information Service in a General Library» [8].

At the second All-Polish Conference of the Polish Librarians' Association devoted to the same questions (June

1972), there were several reports where attempts of this type research were presented.

Finally, one should still mention the necessity to investigate the needs of non-users. This problem has appeared with growing frequency in recent publications, and it is highly likely that this will constitute the next stage of research.

An Inquiry into the Information Service in Two College Libraries

Our objective has been to investigate a selected group of information users, namely, college students.

All over the world studies are being undertaken on the manner in which a student makes use of a library as an aid within the process of education, what are the main difficulties that he has to overcome, whether he can avail himself of the assistance offered by the reference service, and what are his needs connected with it. The inquiry has to provide the answer to the question, whether the library information services perform their work adequately and what can be done to make them more efficient.

The outcome of the inquiry has been to establish that the students often do not know about the existence of reference units, and — ignoring the information sources — make only an inadequate usage of the library stock.

His long-term experience and observations on student use of college libraries have been summed up by M. B. Line, in his report prepared for the IATUL (International Association of Technical University Libraries) Conference [24].He has stated that the reference service in a college library should consist in constant aid on the part of library staff. Training in reference-material use may be helpful, but it does not solve the problem in any conclusive way.

The inquiry into the requirements of students-users was carried out in two colleges of Cracow: in the Academy of Mining and Metallurgy (the AGH), a huge multidirectional technical university, and in the Cracow School of Economics (the WSE), a college of two faculties. The objective of our research has been:

1) to discover the user information/library needs at

the successive stages of the educational process, and to undertake an essay in user classification;

2) to discover the ways by which information is conveyed to the student.

We have treated our study also as an essay in the application of research methods. The investigation was extended above all to senior-year students, i. e., from the fourth through sixth year in the Library of the Academy of Mining and Metallurgy, and third-year students in the Library of the Cracow School of Economics: for, as shown by experience, it is chiefly from them that the reference users are recruited. The investigation included only intramural students, omitting also foreign students atending the two colleges.

Our long-term experience in information service has led us to apply a specially chosen set of research methods. Thus, we recorded queries and our own observations, the record data comprising: the studied discipline and the year of study, the subject content of the questions asked, the objective of the information sought, and the material used. A questionnaire has been prepared, and its results supplemented with interviews conducted with the students: interviews have been made also with the lecturing staff, finally the use of specialized periodicals has been analysed.

The questionnaire investigation was carried out upon two forms. One of them, abbreviated, served to gather information from students during the library information classes (in the AGH Library) and was to bring — in the first place — a record of the way in which the catalogues are used, and the assessment of classes in library use and of the introduction into reference/library service. The second form, with an extended set of questions (identical for the two colleges) was to record equally the search for reference outside the student's own college library and assess the pertinence of the sources of information. The questionnaire forms were non-obligatory and anonymous. Students were interviewed occasionally when they came to return the forms.

In the WSF Library, where the questionnaire inquiry was carried out at the obligatory classes in scientific information for the third year, it was extended to nearly every student. In all, 360 students returned the

completed questionnaire forms — out of the 410 which had been distributed.

In the AGH Library the questionnaire forms were filled by students using the information services, the standarts and patents reading-room and the periodicals-room, as well as by students attending classes in information work, conducted from time to time for some departments at several faculties. More than a half of the questionnaire forms were distributed during seminar classes by the lecturing staff. In all, 600 forms were distributed, of which 350 were filled and returned, which constitutes about 30 per cent of the overall number of the fifth- and sixth-year students.

The inquiry revealed some essential difference in reference use made at the two types of college, resulting both from the peculiarities of the didactic process and from the different approach as made by the technical students and those representative of social sciences to the problems of information and bibliographic reference.

Technical studies do not prepare the student for contact with scientific information; the most valued thing being practical efficiency, the student is not required to present the literature he has worked on, or the process of bibliographic search he has gone through.

Some of the lecturing staff have expressed the view that it is only when the student is starting on his thesis that he should have recourse to reference service and look for bibiliographic aid. As a result, a student does not become a reference user until the moment of his starting work on his preliminary — or even finishing thesis. Contact with information is entered upon usually through the intermediary of a member of the lecturing staff, of a librarian, and often of a fellow student. The situation varies from one faculty to another, and is largely dependent on the respective lecturer's attitude to the problem of bibliographic research and his realization of the reference possibilities offered by the given library, and sometimes upon the user's own activity.

The students of the Cracow School of Economics are required to start early working on the literature of the respective discipline: thus they begin looking for reference earlier than their technical fellow students. Training in library/reference work which for many years has com-

prised all third-year students makes them use the library reference service on a mass scale. The inquiry conducted at the WSE has provided record data highly advantageous to the idea of lectures on information at WSE, to their relevance and effectiveness. A WSE student presents a type of active user, easier to serve than a technical student; he comes into contact with the reference service mostly through the lecturers and librarians. As there are only two faculties at the WSE, the reference work is carried out in a more planned manner, the contacts with research workers are closer, and the schooling is extended partly also to the junior staff within the training courses for the assistants. Thus, the realization of the relevance of information problems is growing all the time.

In a large multi-disciplinary technical university with a highly diversified scope of interests such as the Cracow Academy of Mining and Metallurgy, reference work is much more difficult. There are differences in the way in which the students of the respective faculties make use of the reference aid. There are three faculties, Geology, Ceramics, and Electricity, whose students are particularly active in availing themselves of the information service: they, too, have the greatest number of representatives in the periodicals-room. The ways which lead them to the Information Division vary from one faculty to another.

At the Faculty of Geology students are directed to the information agencies, from the fourth year onwards — above all by the lecturing staff (Over 70 per cent are directed by the person in charge of the classes).

The Ceramics Faculty students have for many years now attended classes on bibliographic and information use since the day on which they start working on their thesis: after that, they usually become information users.

The students of the Electricity Faculty constitute the most conscious (of their needs) and the most numerous group of users. This is probably partly due to the fact that on entering this particular Faculty the students are subjected to a fairly strict selection. The Faculty's students come into touch with the Library Information Division usually directed by a fellow student who has been a previous user. Their activity in the search can be testified to also by the fact that they have recourse to the lar-

gest number of libraries. Classes on information were held at this particular Faculty with the sixth year, when the students had most of the needed literature collected: in spite of this however, they have shown a real concern both with the problem of information itself, and with the presented materials. Also the questionnaire forms filled by them comprised the most mature answers of all.

The users in their answers to the questionnaires postulate that the reference service and the classes in the methodology of bibliographic search and information should have a wider «publicity»: both the service and the classes have been highly appreciated by the students of the two colleges, as highly useful. This view has been expressed both by those who have attended the classes — and by those who have not. Another postulate set forth by the students is for an increase in the number of classes (at the WSE Library the classes take up two to three hours, and at the AGH Library — three to six hours); in their remarks the students have stated in some of the cases that «the classes should be conducted in the library on concrete material, since it is then that they will be pertinent». A large part of the student postulate for the preparing of a guidebook to the information material.

As to the introduction into library use for the first-year students, the general opinion is usually that it is very useful, though some per cent of the fourth- and fifth-year students have stated that it takes place much too early, when a student is inclined to feel rather uncertain or even lost in college life and comes across too many new questions at once; thence he cannot profit by it properly. They have suggested to have classes with extended program in the catalog division during the second term, or even during the second year.

In the Academy of Mining and Metallurgy more than 50 per cent of the students who have answered the questionnaire have complained that they had no proper advice or directions how, once they have settled on the subject of their thesis, they should start working on it and look for the necessary bibliorgaphy; some of them would prefer, taking the line of least resistance, to get their data all ready instead of reaching them on their own. On the other hand, however, in many cases the students really do not get during their studies any vital advice as

to how they should set about looking for information, as may be proved by librarian daily practice. Information given to the students usually amounts to teaching them how to find literature and how to record it.

Among the reference-seekers the most numerous group consists of the fifth- and sixth-year students, working on their theses or on their seminar papers and reports. Next come the fourth-year students, working on projects and preliminary theses. Only in a few cases the reason for information-seeking was the student's own interest, and only twice the reason mentioned was to prepare for the current work at the college. Most users had recourse to information service several times, about 25 per cent once only, and only a few of the students answering the questionnaire — often. Obviously, even these recurrent visits may give rise to doubt, as the student might simply have used for several days the same, once prepared material.

Third-year students come to visit the Scientific Information Division only occasionally, usually to look for encyclopaedias, dictionaries, statistical material, comprised in the reference library.

The library habits of economic users are evolved in a somewhat different way. Here, students come into touch with the information service from the very beginning. First-year students apply for help in selecting a textbook, a periodical title, as well as in their search in the encyclopedias or dictionaries.

Second-year students try to formulate their questions in a more regular way and begin taking interest in the classified catalog with which they always have the greatest troubie; they look also for articles in periodicals. Third-year students usually know already roughly the subject of their prospective thesis (apart from the Institute of Commodity Science, where it does not take place until the fourth year), and take part during the summer term in compulsory (for over ten years now) classes in scientific information (at the Institute of Commodity Science, during the Summer term of the fourth year).

As regards the materials used, the leading part devolves, both in the technical and the economic sciences, upon the periodicals: every year, too, brings a marked increase in the importance of materials hard to obtain, such as

conference proceedings, unpublished research works, doctoral theses, etc. In regard to specialized collections in the technical sciences there is a noticeable growth in the use made of standards, patents and trade and prospectus literature.

The scope of reference material used by the students at the AGH Library is fairly limited. They make use above all of the current analytical bibliography, «Referativnyj Zhurnal» and of the documentation files. The amount of information provided by the documentation files in 1971 was equal to the amount of bibliographic reference provided by analytical bibliographies and other sources. Students especially concerned with chemistry, have recourse also to the American analytical bibliography, «Chemical Abstracts». They use only to a slight degree information bulletins published by the industrial information centres, and do not know how to use documentation reviews in professional periodicals.

The WSE students are willing receivers of information concerning actual economic data, they are always looking for Polish and world statistical reference material. It is only as an after-effect of the introductory classes, though, that one can observe a growing interest in specialized bibliographies and other reference books. Often one can notice a wider demand for publications brought into prominence by some exhibition or other, organized at the library.

Both in the AGH and in the WSE the students use in most cases Polish and Russian literature: thence only a comparatively small per cent attributes a certain difficulty to the inadequate knowledge of foreign languages. These difficulties, incidentally, occur at the faculties where the periodicals in West-European languages are more intensely sought for.

Evidently, proffessional periodicals in foreign languages would be rendered more accessible if the students could resort to reprography and easily obtainable translations.

The investigations conducted in the two colleges have shown that students come across considerable difficulties in their search through catalogues of the UDC type and in the catalogue of periodicals, and that as a result they do not make proper use of these catalogues; when wor-

king with them, students consider it necessary to have the librarian's professional aid.

Apart from the central library, the users look for information at the institute libraries of their respective colleges: these in the years to come ought to be turned into specialized information centers. The AGH students use also the branch industrial information centers, where they are directed by the lecturing staff members who are simultaneously acting as consultants at these centers. They usually apply there for aid, disregarding the library at their own college. Such centers in many cases offer ready sets of subjects, without teaching or explaining how to look for the necessary publications. It is much preferable that the students should apply to such centers only after having availed themselves of information material at the college library.

Of all research methods applied, most useful have turned out to be the interviews made with the students and the lecturing and research staff and the registration of the queries. The questionnaire forms served as control material, they permitted to collect some statistical data and provided comparative material on information needs as felt by students of different specialities. Although the users were quite willing to fill the questionnaire forms, their answers were often chaotic. There were also difficulties related to the terminology by which the material used was defined: it was not until the interview was done that one could establish any conclusive data.

The inquiries were rather fragmentary, both as regards the time when they were conducted, and the number of the students. The research should be extended to students representative of every faculty at the given college. In the Academy of Mining and Metallurgy only some of the disciplines at the different faculties have been tackled, as a result of which the situation might appear under a changed light. In questionnaire investigations the librarians made recourse to the aid of the lecturing and research staff, friends of the Library, thence the over-optimistic picture of information use made by the students of these disciplines. But, while on the one hand this may be regarded us an error in the investigation method, on the other it proves how important is the role and influ-

ence exerted by the lecturers and tutors upon the contacts between the student and the information service.

The restricting of the scope of research above all to users of the Information Divisions Service is tantamount to narrowing the whole issue in view of the increased information function of the library as a whole. This was due to a certain centralization of the information service extended to students at these divisions.

Generally one can state that information even though not adequately utilized as yet, has drawn nearer to the user, that there is a great, not always fully realized readiness to accept it and that sometimes even a small effort will suffice to make the student come into touch with it. Thence the attituds of the information service must be an active one, and the services rendered should be of «good quality».

A planned and mass training will no doubt provide an effective form of answering the user needs: it can be expected, however, that it will also increase the demand for individual information. The introduction into library use and scientific information calls for the application of up-to-date methods and attractive teaching techniques, such as, e. g., a film about library use (at the Academy of Mining and Metallurgy, «Students in the Library»), or the tape-recorded introductory lecture (Cracow School of Economics), since every modern innovation constitutes an encouragement and stimulation to the students.

As shown by experience — and corroborated by the results of our inquiry — a proper assessment of the reference needs of the students and therefore also their proper satisfaction — make it necessary that the librarians should be acquainted with the educational process and co-operate strictly with the lecturing and research staff. The training of the students in the use of scientific information will bring about the desired effect only if it is carried out simultaneously at the institute or the college and at the library from the very beginning of the course of study.

Librarians should share with the lecturing and research staff the responsibility for the education of scientific workers and practicians-specialists, for their general attitude as information users.

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Questionnaire distributed at the AGH Library

The Library requests you to fill the enclosed form, our objective being to investigate the student's needs as to Library Information use.

The results of the questionnaire will permit to improve the methods of library assistance to students in their search for scientific publications.

The questionnaire is anonymous.

Faculty: . . . . . .
Department: . . . . . .
Year: . . . . . .

1. The services of which agencies of our Library have you used *:
   a) The Scientific Information Division
   b) The Main Reading-Room
   c) The Periodicals Reading-Room
   d) The Catalogue
   e) The Lending-Room
   f) The Standards and Patents Reading-Room
   g) Trade and Prospectus Literature Division
   h) The Inter-Library Lending
   i) The Reprography
2. Have you used the services of *:
   a) the libraries of the AGH Institutes and Departments
   b) other Cracow libraries
   c) Branch Institutes Information Centers (such as the Petrol Institute, and others)
   d) libraries at individual plants or works (e. g.,' when the student goes through his course of training)
3. a) Do you consider the introduction into library use during the first year of study to be useful?
      yes
      no
   b) Have you taken part in classes on information and bibliographic use during the fourth or fifth year?
      yes
      no
   Do you consider them to be useful?
4. Do you come across any major difficulties in your search in catalogues (especially in factual, decimal catalogues), and are you in need of the librarian's help?
      yes
      no
5. Have you known formerly about the existence of the Information Division at out Library and about the aid offered by it to the students?
      yes
      no
6. Who has directed you to the Information Division? *
   a) a person on the Library staff,
   b) a professor or another member of the lecturing staff at your Department (Institute),
   c) a fellow student,
   d) you have come on your own?

   How often have you used the Information Division services? *
      once
      several times
      very often

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7. What kind of material have you used at the Information Division? (please list)
8. Have you obtained an adequate and exhausting information? *
   yes
   no
   partly yes
9. What did you seek the information for? *
   a) your thesis,
   b) your preliminary thesis,
   c) papers or reports,
   d) some interest of your own,
   e) other reasons (please list)
10. What difficulties did you come across when working on the subject at issue? *
    a) absence of directions or advice,
    b) inaccessible material (if so, what material)?
    c) inadequate knowledge of foreign languages,
    d) other reasons (please specify)
11. What type of material have you used when looking for bibliography to your preliminary or finishing thesis (please list according to their respective usefulness) *:
    a) documentation files (abstracts, articles, periodicals),
    b) bibliographies,
    c) reference periodicals (Referativnyj Zhurnal, Chemical Abstracts, and others),
    d) reviews of documentation material,
    e) encyclopaedias and encyclopaedic dictionaries,
    f) periodicals and scientific and professional works,
       Polish
       foreign
    g) standards, patents, trade and prospectus literature
    h) other sources (please list)
12. Your remarks and suggestions for rendering the Library information service more efficient.

* the proper answer should be underlined